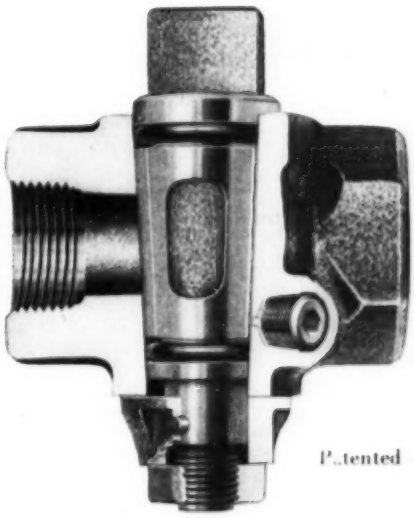
MUELLER LubOseal® GAS STOP

fulfilling the need for a really SAFE gas meter stop



Patented

Increased demand for gas has led to higher pressures and resulted in a need for a gas meter stop that would meet the following requirements:

Should not leak at high pressure
Should retain its pressure-holding characteristics for a maximum time
Should be easily operated
Should retain its ease of operation for a maximum time
Pressure-holding characteristics and low-turning torque requirements easily renewed
Should be really tamperproof

Mueller engineers developed the LubOseal Stop which meets or surpasses all of these requirements.

It has withstood pressures up to 4800 psig without top or bottom leakage.
"O" ring seals top and bottom assure no top or bottom leakage.
"O" rings store lubricant pressure.
Lubricant under the pressure of the "O" rings is evenly distributed over *all* ground key surfaces each time the stop is operated.
Easily re-lubricated with a minimum amount of grease through independent port in body.
Tamperproof design achieved through steel drive pin in blind hole holds key in intimate contact with body even with nut removed.

Would you like to test the LubOseal Stop? We will furnish either the H-11175 Lock Wing *or* H-11170 Plain Head. Sizes ¾" through 2". *Write to Mueller Co., Dept. 36, Decatur, Illinois.*

GAS

30th Year of Publication

MARCH 1954 · VOLUME XXX · NUMBER 3

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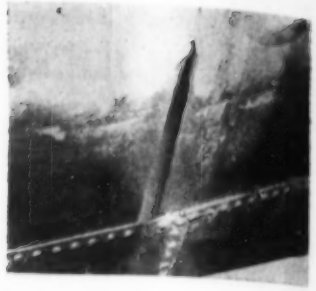

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Seattle Gas Co. had to repair cracks like this. How rapid repairs were made is told on pages 40-43.

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Thermally Thinking

SPOT NEWS AND COMMENT ON GAS INDUSTRY AFFAIRS

Highlighting the News

Reconversion to oil for Little Big Inch?

Texas Eastern, which bought the Big and Little Big Inch lines from the government after they had served throughout the war as vital oil carriers, is contemplating reconversion of the smaller line to oil or products transport. A final decision is expected momentarily. Texas Eastern's producing subsidiary is buying Triangle Pipeline Co.'s system, with which it would connect the Little Big Inch. Main reason for the move: economics. Proposed additional loops and feeders for the Big Inch might provide more volumes at less cost. Little Big Inch's capacity is limited by its 20-in. diameter.

Financing record set in 1953

AGA's preliminary tabulations show that aggregate financing reached $1049 million, compared with 1951's $909 million and $756 million in 1952. Common stock issues of $160 million more than doubled the previous high, set in 1950, and were two-and-one-half times the 1952 mark. Preferred issues were down slightly, but bond issues of $573 million were $10 million ahead of 1951's record. Changes in cost of capital strongly influenced the shift in ratios.

Natural gas for the far north

A 450-mile line from Gubik on the Colville river to Fairbanks, Alaska, is contemplated by a group of Fairbanks businessmen. Proved reserves of dry gas reported at 300 billion ft would be tapped for a $20 million, 8-in. line. The line would be built on the permafrost and covered by moss to prevent thawing. As a replacement for coal, gas would be 30% cheaper, according to the promoters.

Nevada has natural gas

First natural gas in the state of Nevada was due to reach the Henderson regulating station by Feb. 20. A 12-day conversion schedule was set up by California-Pacific Utilities Co., local distributor. The fabulous resort, Las Vegas, and surrounding communities and major industries will soon be completely served from the Nevada Natural Gas Pipeline Co.'s 110-mile transmission main, which carries gas from El Paso Natural Gas Co.'s system near Topock on the Colorado river.

Depletion allowances to stand

There is little or no chance that Congress will tinker with the 27.5% oil and gas depletion allowance this year, although labor organizations and other consumer groups are bearing down heavily in their propaganda. The President, Treasury Secretary George Humphrey, and Rep. Daniel A. Reed (R.-N. Y.), chairman of the tax-writing House Committee on Ways and Means, all see eye-to-eye on the depletion allowance. Both Senator Hubert Humphrey (D.-Minn.) and Senator Paul H. Douglas (D.-Ill.) are loud in their objections to this "loophole," and they may put up quite a battle when the tax measure finally reaches the Senate floor, sometime in April or May. They say that it represents a gift of $750 million a year to oil and gas producers.

Alberta going slow on all-Canadian line

The way seemed cleared for the big gasline which is to run from Alberta to eastern Canada (GAS, February, page 37), but Alberta is reportedly seeking more information before it gives a final "yes." Pipeline officials are scheduled to appear before provincial officials for a hearing March 22.

Pakistan plans gasline

Gas has been discovered in quantity in the Baluchistan desert and a major transmission pipeline is being planned to carry the gas to the nation's industries. Proved reserves are estimated at 2280 billion cu ft.

Big electric growth forecast

General Electric's chairman, Philip D. Reed, is quoted as predicting that by the year 2000, the U. S. will be using 20 times the electricity consumed in the nation today. For the immediate future, he prophesied that a combined electric heating and cooling device (presumably the heat pump) will be cheaper to operate than conventional oil, gas, or coal units.

An Eye on the Capital

Gathering tax decision clue to Phillips review

The decision of the U. S. Supreme Court in the matter of the constitutionality of the so-called Texas gas gathering tax (see Pipeline News in this issue) may give a clue to what's ahead when the high court reviews the Phillips decision, as it may soon. For producers, the news will not be good.

Justice Tom Clark, who delivered the opinion, ruled that the Texas statutory definition of "gathering" did not conform to the usual and ordinary meaning of the term. He asserted that since the Texas law applied to gas at a point where it passed from a producer's plant into pipelines of the gatherer, it was, in effect, a tax on gas already moving into interstate commerce and, therefore, is invalid. The court carefully made a distinction between this case and that of the Utah Power & Light Co. versus Pfost (a 1932 opinion which upheld a Utah tax on the generation of power). It pointed out that there was no change involved in the nature of the gas as a result of the "gathering" oper-

Thermally Thinking

ation, which was the basis for the tax.

The Federal Power Commission, as is not usually the case in gas matters affecting the nation, had no part in the test litigation, since, officials said, it was purely a state matter. However, the court's views on the interstate commerce character of "gathered" gas, moving between the point of production and pipeline, are not believed to strengthen the case against FPC jurisdiction over production and gathering under the Natural Gas Act. The high court's agreement to review this question in the controversial Phillips Petroleum Co. case, still is to be argued.

Lawyers for the appealing company in the Texas gas gathering case said that the burden of the tax ultimately would be borne by persons in the 38 states in which Texas gas is distributed, and they added:

"Thus the tax statute enables Texas to achieve the politically popular result of raising revenue at the ultimate expense of citizens of other states."

Producers face increasing opposition

The popularity of this ruling with the voters, like the Supreme Court's original ruling in the Phillip's case, underscores the fact that with the post-war expansion of natural gas into all parts of the nation, and particularly in the heavily-populated states, there is great public interest in the natural gas industry.

There were not one, but many, communities interested in the outcome of this case. The news was played prominently in such heavy population centers as Newark, Chicago, and Minneapolis, as well as in Texas. Every time the natural gas industry has grown, so to speak, and has added another thousand customers to the varied lines, it has complicated its problems, and the problems of the gas-producing states.

In Washington's political atmosphere, it is taken for granted that the politicians who must woo the votes of these thousands of consumers, as contrasted to the few votes represented by the stockholders of gas companies, take a great interest in these court decisions. They also are watching legislation on which, if they vote, they might find a split in their own party ranks.

This explains why the Hinshaw Bill, (to remove intrastate gas distributors from FPC control), for instance, is *not* likely to be taken up after the Bricker Amendment question has been settled in the Senate. It is whispered in the Washington labyrinths that this bill has been given the kiss of death for this session, since its passage would put another missile in the hands of the Democrats who are crying "giveaway" in speech after speech all around the country. There's no question but what the "giveaway" theme is very popular in many circles and that any additional moves that seem to indicate any antipathy to the consumer, or solace for business, will herald another cacophony of catcalls from the Democrats. It's considered by the shrewder politicians here that enough people are upset already, without adding to the discontent.

Consumer reaction (as exploited by local politicians) has shown up in various ways, in Congress, in relation to the natural gas industry. For instance, Rep. Roy W. Wier (D.-Minn.), who hadn't previously shown too much interest in natural gas, suddenly awakened to its possibilities. He introduced H. R. 7624, which would make changes in rate suspension provisions of the Natural Gas Act. His legislation, as he explained it personally, was introduced at the behest of the mayor and other politicians in Minneapolis who wanted to have in the hopper legislation that was "just the opposite of the Lyle bill." Representative Lyle, of course, is a Texan, where the producers live. Mr. Weir is from Minnesota, where the consumers live.

Competitive bidding rule may be relaxed

The Securities & Exchange Commission has disclosed here that there were 48 electric and gas holding company systems registered with the agency at the end of fiscal 1953—last June 30.

These include 173 electric and gas operating companies. During the year, the SEC reviewed and passed upon $779 million in electric and gas subsidiary securities. SEC said that this total included $426 million of bonds and debentures, $81 milion of notes, $70 million of preferred stocks, and $202 million of common stocks.

Meantime, the SEC has opened hearings here on its "competitive bidding" requirements, and, among others, Sen. Henry Jackson (D.-Wash.) voiced early disapproval of any changes.

The SEC is studying an amendment of its rule which requires competitive bidding for the purchase of underwriting of securities issued or sold by registered utility holding companies or their subsidiaries. A proposed change in SEC's Rule U-50, under the Holding Company Act of 1935, would free subsidiaries of a holding company from the competitive bidding requirement if the subsidiary is not itself a holding company, and if it is under state commission jurisdiction.

A number of competitive bidding advocates have made plans to be on hand to dissent vigorously to any change in the present rule, or to the substitution of negotiated sales.

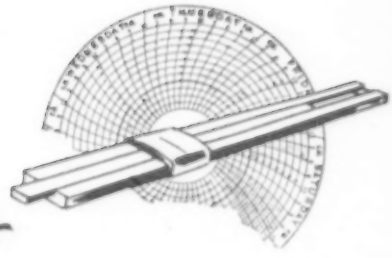
PUC can order gas purchase

The U. S. Supreme Court has acted in another gas case but the result was not headlined, for no precedents were set, or shattered.

The court has dismissed a petition by the Amere Gas Utilities Co. of West Virginia, which had attempted to obtain a review by the highest court of a West Virginia utilities commission order previously upheld by the state court.

The principal point at issue was whether or not the commission legally could order the gas company to purchase its supply from sources other than the company's parent. West Virginia judges believe that the commission has such power, and the Supreme Court did not seem inclined to argue with them.

Technical Trends



* By GUY CORFIELD

Plastic pipe specifications

While several gas companies have made extensive use of plastic tubing for underground gas piping, and a few are adding to their installations at varying rates,* the general attitude seems to be to observe and evaluate results or watch what others have done, as the case may be, meanwhile looking to the manufacturers for more information on existing plastics and development of possibly better types of material. The operating conveniences and economies of plastic tubing have been observed, such as light weight, ease of installation and jointing, apparent immunity from corrosion or other deterioration, etc. It has been recognized that plastic is potentially an alternate for or perhaps is superior to the traditional steel and cast iron, at least for low or intermediate pressure use. However, it is felt that more should be known about plastics as construction materials, not only as regards strength and performance under various conditions of service, and permanent retention of initial properties, but also with respect to test methods for evaluating and comparing performance of the wide variety of types and formulae now available.

Any evaluation of plastic for underground gas piping unavoidably involves its comparison with iron, and the natural tendency is to consider the same dimensions and apply the same physical strength test methods. Regarding dimensions (diameter and wall thickness), it has been conventional with steel pipe to have wall thickness much greater than necessary to withstand operating pressures, presumably to afford an allowance or safety factor for corrosion. If plastic tubing is immune to corrosion or other deterioration it would seem that wall thickness could be strictly in accord with required physical strength to withstand expected operating pressure and other incidental stresses.

However, the evaluation of required physical strength is not simply a matter of a quick bursting or tensile strength test as would be applied to metal. As might be expected from the very name "plastic," the material tends to slowly creep or stretch with sustained stress of much lower magnitude than that which will cause failure under rapid application, and temperature changes of only a few degrees make a decided difference in strength. Fortunately there is apparently a stress below which plastic of a given dimension and at a given temperature will show an initial slight creep and then resist further stretch or deformation — seemingly remaining within its "elastic limit" — and presumably design should be such as to operate below these limiting conditions. All other means of evaluation by test should be similarly explored, keeping constantly in mind that plastic materials are in many physical characteristics unlike steel or iron, and the conventional metal testing criteria are not necessarily applicable.

Resolving the questions

It is a natural question for a plastic pipe vendor to ask a gas industry engineer, "What do you want in the way of plastic pipe?" but just as natural for the engineer to reply "What do you have to offer?" The gas industry and the plastics industry are now in about this position, and it is the aim of the currently active AGA plastic pipe standards subcommittee (a subcommittee of the distribution committee) to close this gap. The subcommittee has, by questionnaire, ascertained the requirements of the gas industry and passed them on to the Society of the Plastics Industry, and through meetings of the two groups will attempt to develop specifications or standards which it is hoped can be based on evaluation and acceptance criteria, leaving opportunity for improvement as the "art" progresses.

Three phases

There appear to be three general phases to the problem: first, the basic chemical and physical properties of the plastics, to give immunity from deterioration and adequate long-time physical strength; second, the dimensions of the various nominal sizes, to permit a reasonable degree of standardization of diameter and wall thickness; and, third, the means of and fittings and accessories for making joints, connections, etc.

The first of these phases has already been discussed. With respect to dimensions of tubing, and if such tubing is used to pull through existing corroded steel or cast iron pipe, the outside diameter is obviously limited, but the wall thickness is also limited to the degree that adequate gas carrying capacity must be provided, and therefore a plastic which might be very cheap (by the pound) but which required very thick wall for physical strength, would not be useable because of the capacity limitation. The wall thickness limitation is not of itself so important for tubing that will be buried direct in the soil except that, for a given internal diameter, if the external diameter is much greater than the metal pipe to which it will be connected the use of conventional metal pipe compression couplings will not be possible and special fittings will be necessary for the plastic-to-metal joint. The various problems of jointing, plastic-to-metal and plastic-to-plastic, and of making side-connections, to obtain the strength and permanent leakproofness that are essential to gas operations, are rather obvious and may vary considerably with different types of plastic.

*See January *GAS*, pages 42-44.

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of accurate measurement and dependable regulation

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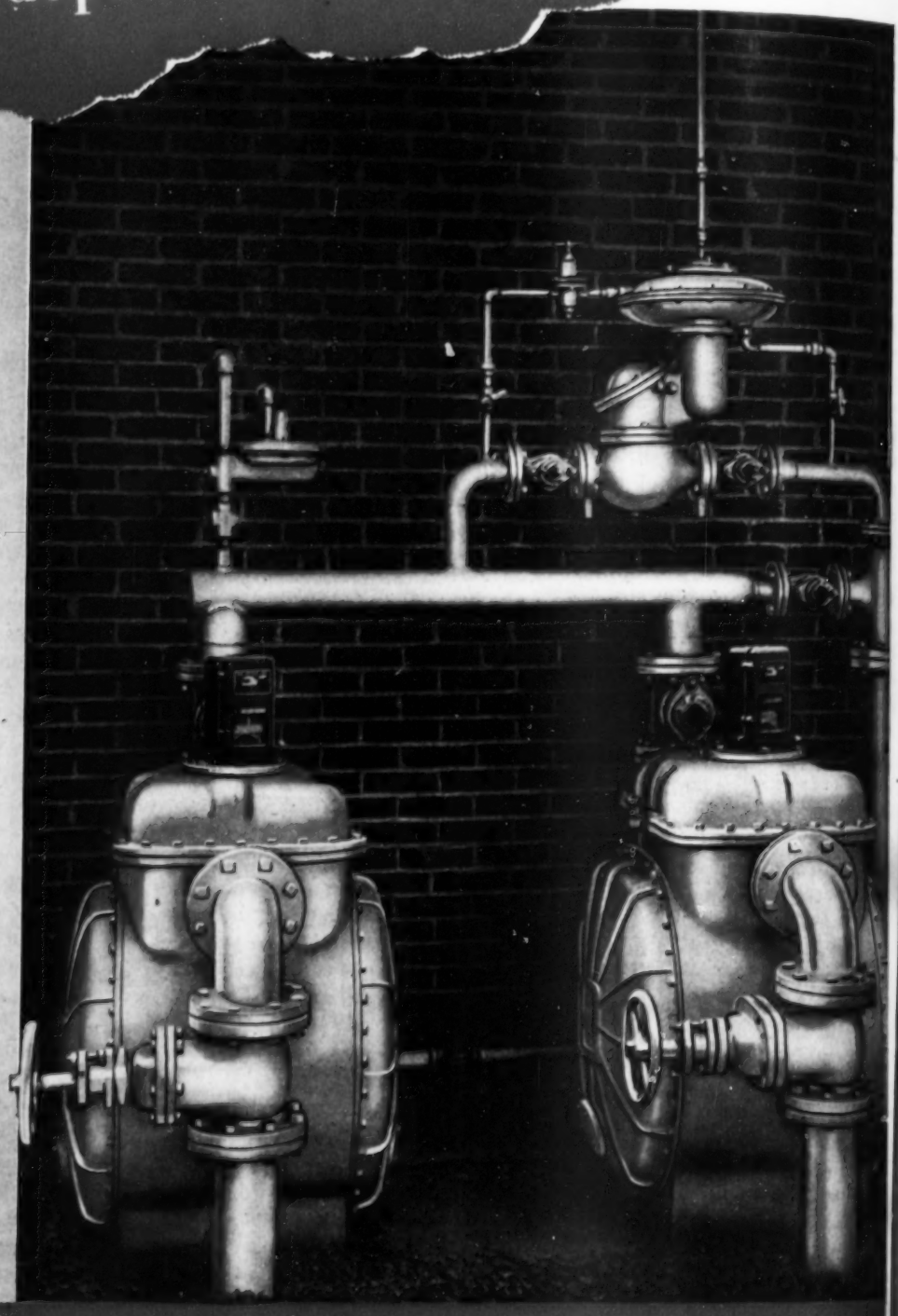
RELIANCE REGULATORS

AMERICAN BASE PRESSURE INDEXES

American 500B Ironcase Meters measure gas in this high pressure industrial installation and Base Pressure Indexes indicate the gas quantities, computed to base pressure conditions, totalized on a counter. A Reliance CBV Regulator, pilot-loaded with a Type Z Regulator, controls main pressure while a Reliance Service Regulator provides a separate connection.



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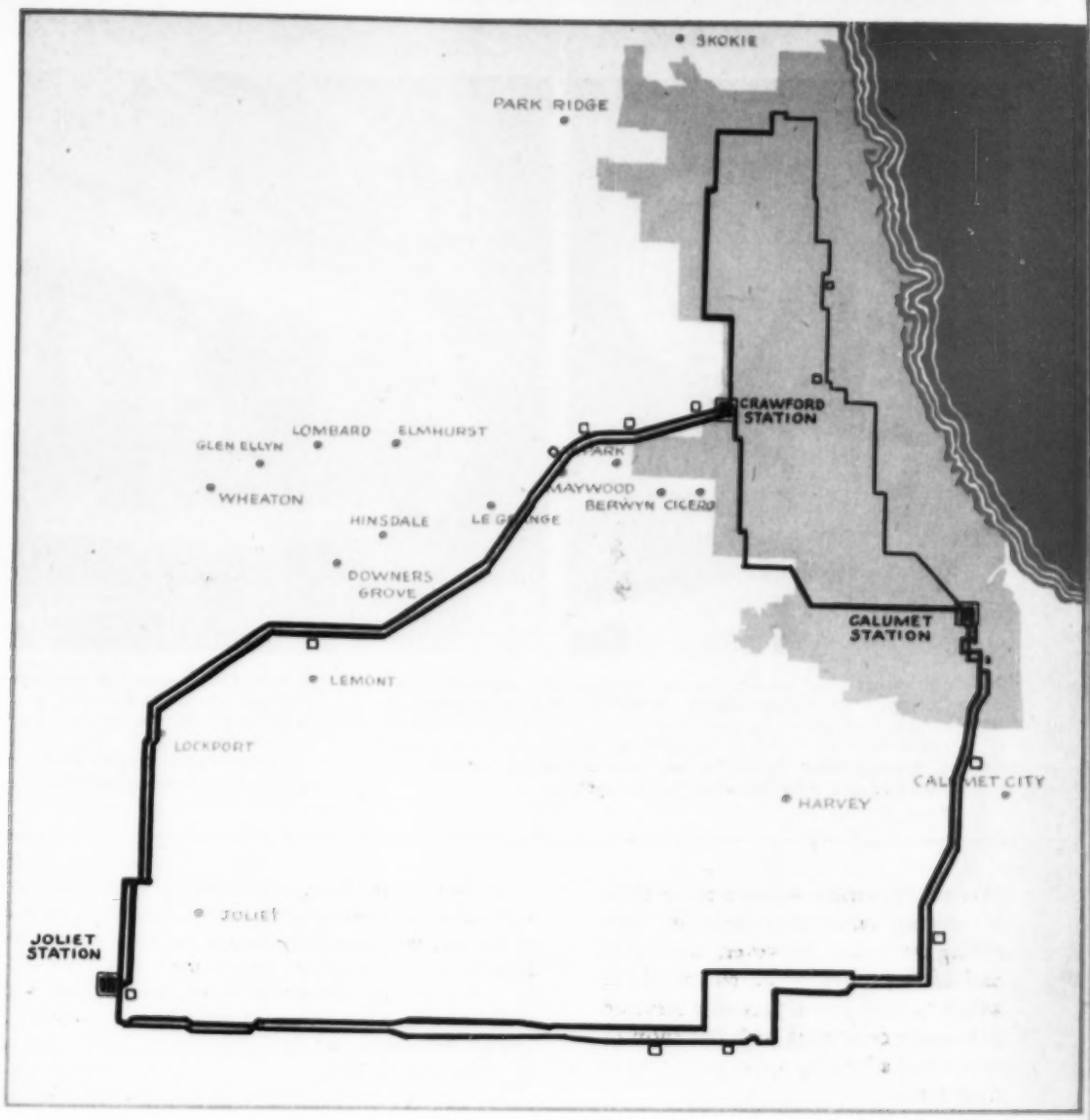


In Chicago, Peoples Gas Light & Coke Co. maintains a constant 900-Btu heating value despite the fact that gas is obtained from a number of sources. Tying rates to fluctuating heating values is a problem that many utilities are facing at the present time.

Heating value rate adjustments

With what appears to be a trend in some sections of the country toward the use of heating value adjustment of one kind or an other, standard techniques for determining the Btu of gas delivered are of increasing importance.

By **FRANK CHAPMAN** • Editor

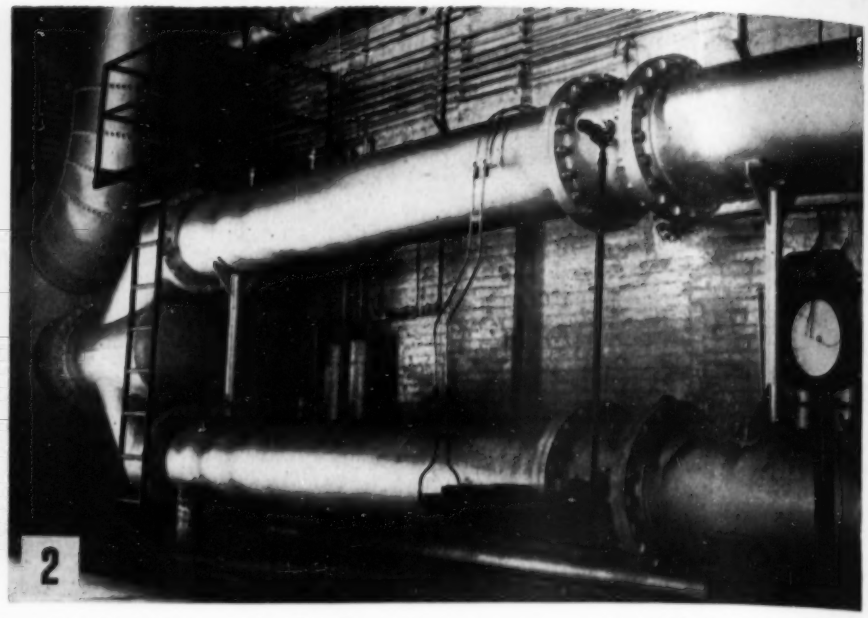
A GAS distribution company with some rate structure provision which takes into consideration the heating value of the fuel delivered to the customer is faced with the costly and highly complicated job of developing some means of knowing the Btu content of this gas within tolerances specified by the rate structure under which the company is operating. The problem is further complicated by the manipulations required to convert Btu heating value readings as recorded throughout the system into actual billing figures.

At the present time more than 40% of the country's natural gas customers have a heating value adjustment of one form or another in their billing structure. Those provisions are either in the form of a straight therm rate such as that used by the Peoples Gas Light & Coke Co. in the Chicago area or in the form of a Btu adjustment clause such as that in force in many other parts of the country.

A state-by- state tabulation of natural gas customers and the type of heating value provision or adjustment, if any, that is used in their billing process is shown in *Table 1*.* Only three states

*Data on the number of customers serviced by each company were taken from the 1953-54 Directory of American Gas Companies, and information on the rate

1—Calorimixer that is used by the Peoples Gas Light & Coke Co., Chicago, to automatically determine the proportion of natural and manufactured gas that must be mixed to produce a constant 900 Btu gas. The machine also actuates a mixer control that operates valves in two lines delivering natural and manufactured gas into the distribution system.



2—Two lines entering a common mixing chamber at one of the Peoples Gas Light & Coke Co. Chicago stations. One line carries natural gas to the mixing chamber while the other line carries manufactured gas. The mixture is controlled to maintain a constant value of 900 Btu with a hydraulic operated valve in each of the lines controlled through a calorimixer.

have no customers without some form of heating value adjustment in their billing structure. However, more than half of the states, or 22 out of 41, in which natural gas is presently serviced have some customers with one form or another of a heating value provision in their rates.

The Peoples Gas Light & Coke Co. has nearly one million customers on a therm rate structure. The therm rate, however, is also used to considerable extent in four other states: Arizona, Iowa, New Jersey, and Wisconsin, and in the District of Columbia. The absence of any provision for taking Btu value of the gas into consideration in Louisiana, Ohio, Pennsylvania, and Texas accounts for more than half of the total number of customers in that category.

Common pattern

Heating value adjustment clauses usually follow a common pattern whether they are applicable to all rates or only to industrial and large interruptible-service customers. A representative sample is the clause that is contained in the Alabama Gas Corp.'s Montgomery schedule for large interruptible service, which reads:

"In the event the Btu content of the gas varies above or below 1000 Btu per cu ft of dry gas, the commodity charges shall be adjusted by multiplying such charges by a fraction, the numerator of which shall be the monthly average of the daily average Btu content and the denominator of which shall be 1000."

More explicit

In other instances the heating value adjustment clause is more explicit as to the manner in which the adjustment in rates is to be made. A sample of this kind of clause is that which is found in present California rate structures, and reads as follows:

"The base rates set forth in the schedules for natural gas are predicted on an average monthly heating value of 1100 Btu per cu ft (determined as the average of daily heating value tests on a dry basis). A maximum variation in the monthly average of 35 Btu above or below the Btu on which the effective rates are based is contemplated. When the actual variation exceeds 35 Btu for two consecutive calendar months, the effective rates will be changed by increasing or decreasing the rates to conform to a new average heating value, adjusted in steps of 50 Btu from the base of 1100 Btu, which is the nearest the average of that experienced during the two months that occasioned the change. The effective rates will be determined by an adjustment in all base rates (except for the fixed and/or the minimum charge portion of the general service and space heating rates) in accordance with the percentages set forth below for each 50 Btu step, computed to the nearest 0.01 cent per 100 cu ft or 0.1 cent per 1000 cu ft and will become effective 15 days thereafter.

General natural gas service schedule, 3% per 50 Btu step.

Military natural gas service schedules, 3% per 50 Btu step.

Multiple dwelling natural gas service schedules, 3% per 50 Btu step.

Firm industrial natural gas service schedules, 2% per 50 Btu step.

Gas engine natural gas service schedules, 2% per 50 Btu step.

Interruptible natural gas service schedules, 2% per 50 Btu step.

Changes in the rates resulting from variation in heating value will not be made more frequently than each two-month period, except, when definite changes in the source of gas occur, the appropriate rates will be made effective 30 days after the date of changeover."

Applied to larger users

In those instances where a heating value adjustment clause does not apply to all rates, it is usually applied to the large industrial or commercial users. The same is generally true where some schedules are computed on a straight therm base. In some instances the therm or heat adjustment clauses are included in optional schedules for large users.

The application of both therm rates

structure of each of the companies was taken from the most recent information available in the AGA Rate Service compiled by the Bureau of Statistics of the AGA.

TABLE 1. CUSTOMER AND HEATING VALUE PROVISION TABULATION

	TOTAL	A1	A2	A3	B	C
Alabama	221,939	19,057		202,882[1]		
Arizona	147,609	16,860			130,749[8]	
Arkansas	143,000	143,000				
California	3,091,992	102,662	2,989,330[2]			
Colorado	213,346	213,346				
Connecticut	mfd.	—				
Delaware	50,176	50,176				
District of Columbia	177,617	—			177,617	
Florida	13,722	13,722				
Georgia	153,267	4,500		145,253[3]	3,574	
Idaho	—	—				
Illinois	1,770,544	37,583			1,732,962	
Indiana	558,277	512,248		46,049[4]		
Iowa	268,566	106,711			100,168[9]	61,687[5]
Kansas	170,214	170,214				
Kentucky	54,248	54,248				
Louisiana	923,826	923,826				
Maine	mfd.	—				
Maryland	397,860	17,307	321,196[6]		59,357[7]	
Massachusetts	170,851	170,851				
Michigan	992,243	496,274				495,969[10]
Minnesota	341,164	252,250	88,914[11]			
Mississippi	167,382	167,382				
Missouri	954,818	619,366			335,452[12]	
Montana	83,836	83,836				
Nebraska	210,118	143,280				66,836[13]
Nevada	—	—				
New Hampshire	1,487	—			1,487	
New Jersey	238,138	—			238,138	
New Mexico	102,682	102,682				
New York	683,893	683,893				
North Carolina	26,518	26,518				
North Dakota	4,581	4,581				
Ohio	1,695,810	1,695,810				
Oklahoma	475,279	118,313		356,966[14]		
Oregon	mfd.	—				
Pennsylvania	1,014,293	978,287			36,006[15]	
Rhode Island	mfd.	—				
South Carolina	8,894	7,775			1,119[16]	
South Dakota	31,611	18,275			13,336[17]	
Tennessee	175,247	136,357			38,890[18]	
Texas	2,199,442	2,199,442				
Utah	88,853	88,853				
Vermont	mfd.	—				
Virginia	208,953	152,884	6,977[20]		49,092[19]	
Washington	mfd.	—				
West Virginia	148,498	148,498				
Wisconsin	384,170	85,074			290,494[21]	
Wyoming	43,072	43,072				
TOTALS	**18,808,036**	**10,808,013**	**3,406,417**	**751,150**	**3,208,441**	**624,492**

1. Includes heating value adjustment on large interruptible-service schedules in Birmingham and on small industrial and large interruptible service schedules in Montgomery.
2. Areas serviced by PG&E, Southern California Gas Co., and Southern Counties Gas Co.
3. Includes heating value adjustment in interruptible gas service schedules, industrial and low cost housing mill village rate when deliveries have been more than 200 Mcf per day in any one day, during the current and preceding 11-month period in Atlanta; and on industrial service, low cost housing service and an optional rate for industrial (dump) service in Columbus, Ga.
4. An optional rate in Hammond for industrial and other large consumer service based on the Btu of the gas delivered.
5. A straight therm rate for restricted interruptible service and on an optional basis for large commercial and industrial users in Cedar Rapids; and on large industrial rates in Davenport.
6. Baltimore.
7. Areas serviced by Washington Gas Light Co. of Maryland.
8. Phoenix and Tucson.
9. Des Moines and Sioux City.
10. Therm rate on schedule for internal combustion engines and for large volume service in Detroit, and an optional rate for large industrial users in Adrian.
11. St. Paul.
12. St. Louis.
13. Therm rate on general service in Omaha.
14. Heating value adjustment on commercial and industrial service in Tulsa and Oklahoma City.
15. York (Pa.) County Gas Co.
16. South Carolina Gas Co., Gaffney.
17. Sioux Falls.
18. Knoxville, Nashville, and Cleveland, Tenn.
19. Rosslyn Gas Co., Arlington county, Va.
20. Heat value adjustment on commercial and industrial rates in Danville, Va.
21. Wisconsin Natural Gas Co., Racine.

A. Rate based on cubic feet.
1. No Btu heating value clause.
2. Btu change clause included in all rates.
3. Btu change clause included in some rates.

B. Rate based on therms.

C. Rate a combination of therm and cubic feet.
No Btu heating value clause on those rates based on cubic feet.

and heating value adjustment clauses in certain rate schedules brings up the question of how the heating value of the gas delivered to any specific customer is to be determined. Where a service area is supplied from a common source of gas, such as one pipeline through a single city gate station, the use of a calorimeter or similar measuring device on the source of gas will provide the necessary Btu rating on gas delivered to all customers. Also, where a service area is supplied with a combination of manufactured and natural gas the problem of determining the exact Btu value of the gas in the mains is simplified by sending out a mixture that is controlled through a calorimeter.

Multiple feeders

However, where a service area is supplied by natural gas from more than one transmission line through more than one city gate station or point of input to the distribution system, wherein it is likely that the heating value of the various gases supplied will vary in Btu content from time to time, a highly technical calculation is required to establish the Btu value of the gas delivered to any one customer in the system.

In some instances where gas is delivered to a distribution company through a single city gate station the rate schedule designates the manner in which the Btu heating value of the gas is to be determined. An example stipulation of this kind, as used in the Alabama Gas Corp.'s Montgomery rate says that, "for the purpose of determining such average heating value, the company may rely on the accuracy of the reports furnished to it on such heating value by the company's supplier."

Heat measuring

In those instances where the Btu heating value of the gas enters into the cost of gas to large industrial customers the problem is also simplified by the use of a heat content measuring device on the customer's service line. The Northern Indiana Public Service Co.'s optional industrial service rate for the city of Hammond, Ind., specifically indicates two methods which may be used in determining the Btu value of the gas delivered. This rate stipulates that:

> "Maximum demand per month expressed in millions of Btu's may be determined at the option of the company by either of the following methods. By observation: The maximum demand per month, expressed in millions of Btu's shall be under the number of millions of Btu's used during the hourly period of observation during which period the number of millions of Btu's used is the highest during such monthly period. By meters and instruments: The maximum demand per month shall be the number of millions of Btu's used during the hourly period in which the number of millions of Btu's used is the highest as determined from the registration or indications of meters and other instruments during such hourly period."

In most rate schedules, however, there is no reference as to how the actual Btu value of the gas delivered to a customer is to be determined, and in none of the schedules applicable to all customers is there any such indication.

In the case of a distribution company that is forced through its rate structure to bill on a therm rate or make a rate adjustment on the basis of the Btu heating value of the gas delivered, some provision must be made for determining the Btu value of the gas delivered to any customer on such a schedule. If the company's mains are supplied with gas from more than one source the problem of knowing, with fair accuracy, the Btu of the gas delivered to a sample customer located somewhere in the middle of the service network is costly and involved.

How Peoples operates

The Peoples Gas Light & Coke Co., which services the Chicago area on a therm rate, presents an example of one solution to such a problem. Peoples Gas receives gas through two lines of the Natural Gas Pipeline Co. of America from the Panhandle area of Texas, and through a newly completed 30-in. line of the Texas Illinois Natural Gas Pipeline Co. from the Texas Gulf coast. These lines converge at Joliet, Ill., where Peoples Gas purchases the gas in therms. Calorimeters and Junkers sampling equipment are used to determine the Btu of the gas purchased. The gas from the three lines is carried by the Chicago District Pipeline Co. system from Joliet to the Peoples Gas Crawford and Calumet stations where it is fed into the distribution system.

Natural gas at Crawford and Calumet stations measures 1000 Btu or more. At Crawford station the company maintains a coke oven and an oil-gas plant, and at Calumet low-Btu gas is purchased from steel mills. This manufactured gas is mixed with natural gas at each of the stations to deliver a constant 900 Btu gas to the city's mains. A Calorimixer at each location automatically determines the proportions of manufactured and natural gas which are to be mixed to maintain the 900 Btu level.

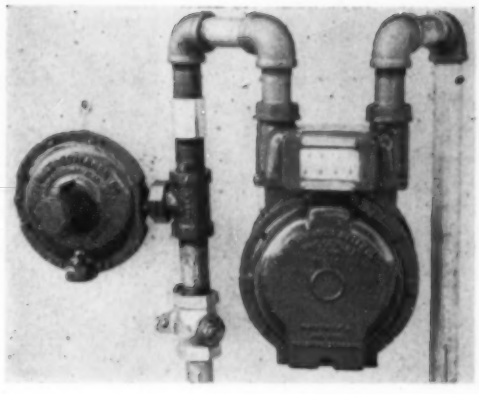
A cross-city line also carries natural gas from the Crawford station to four other distribution points within the city that are used only for peak shaving. Each of these stations has provisions for manufacturing oil gas and an arrangement similar to that used at Calumet and Crawford is used, when the stations are in operation, for mixing manufactured and natural gas for an output of 900 Btu gas.

Therefore, with gas entering the Chicago system at two, and often more, different points, a constant level of 900 Btu gas is maintained throughout the entire system through the use of a carefully controlled mixture of natural and manufactured gas.

Tough problem

Regardless of the method of gas supply, the problem of a method for determining the Btu of gas delivered to any one customer is one which must be reckoned with in all cases where a rate structure includes some such consideration in one form or another. Where the gas is received from only one source the problem is substantially one of knowing the Btu of that source of supply. When a mixed gas is supplied the problem is simplified through the use of a controlled mixture. It is in the case of a company that must supply its system from a number of sources which vary in volume and Btu rating that the problem becomes highly technical and complicated. In the latter instance competent personnel and highly technical equipment necessary to carry out an accurate system of Btu measurement in a large distribution company results in an expense that can be said to add to the cost of gas to the consumer.

Because of the technical nature of measurement procedures in a large distribution system the lead in establishing standard techniques for measurement should be undertaken by the gas company. The Btu measurement of gas in a complicated distribution system is a job for expert and trained personnel. Methods prescribed for the job by persons other than those well acquainted with the problems involved could be more expensive and less accurate than present methods.



Alternative methods of providing for regulation on service connections when a distribution area is converted from low to intermediate pressure are pictured at right. The use of a combination meter-regulator (far right) is contrasted with the arrangement required when a separate regulator is used.

By **H. H. SEXTON**
Houston (Texas) Natural Gas Corp.

Houston's experience with combination meter regulators

THE conversion from low to intermediate pressure in two similar distribution areas within the city of Houston at about the same time has led to a comparison between the use of a meter and separate regulator for service connection to an intermediate pressure system, as used in one of the areas, as against a combination meter-regulator, as used in the other area.

Some time ago Houston, along with many other cities throughout the country, found itself in the middle of an unprecedented building boom which was not anticipated at the time the city's low pressure systems were designed. Consequently, as the boundaries of the city moved outward the Houston Natural Gas Corp., which services the area, found that many of its mains were too small to carry the added load under low pressure. The River Oaks section of Houston and the city of West University Place were two areas in which it became necessary to convert from low to intermediate pressure in order to satisfy the increased demand.

In the conversion of the River Oaks section, which was undertaken first, each service connection was provided with a separate regulator, while a combination meter-regulator was used in the University Place section, converted a short time later. Because of the similarity in size of the two areas, a comparison was made with respect to the use of the two methods of pressure conversion.

Conversion of the River Oaks section was started in June and completed in fall of the same year. Sprague house regulators with 7/16-in. orifices were installed to insure an adequate supply of gas to the customer during changeover, with only 8 oz of pressure on the upstream side of the regulator. After regulators were installed on all of the approximately 2500 service connections, gas pressure was gradually increased from 8 oz to 5 lb. Customer appliances were checked and adjusted when necessary during the conversion.

The West University Place conversion, making use of the Sprague combination meter-regulator, was undertaken a couple of years later. At the time this was one of the first major installations of the combination unit. Although the project was started at about the same time in the spring as the River Oaks conversion, it was completed long before fall. Time required for the complete conversion was approximately 30 work days as against about 50 work days for the River Oaks project.

The basic factor in the saving time was the manner in which the combination meter-regulator took the same service connections and fit the same space as the original meter. For all practical purposes, the time required for the conversion of a service connection was about the same as that ordinarily required for the routine changing of meters.

With the installation of the separate regulator, however, it was necessary to relocate the service connections to accommodate the regulator in the service loop. In the River Oaks area, for example, this involved the use of two nipples which were made up and installed by the conversion man along with the regulator in each service connection. It was necessary for the conversion man to cut and thread risers at each location. Because of the additional time required in rebuilding the loop for such a conversion, the West University Place project with combination units was completed in an estimated 50% less time for a total saving of 415 man hours.

Aside from the cost of the time involved, a quick conversion was found to be in the interest of good customer relations. Although both conversion projects were carried out with equal attention to customer appliances, the West University Place conversion drew less public notice because of the speed with which it was accomplished.

A substantial saving in space, particularly in multiple installations such as apartment house connections where space is an important item, resulted from the use of the combination unit in place of a separate regulator. In many instances, also, the appearance of the combination unit was important, in the eyes of the customer, over an installation of a separate regulator.

Other advantages were found in the day-to-day use of the combination unit after the conversion was completed. For one thing, the methods of accounting for the meters and regulators in service were simplified because one meter number could serve to identify both the meter and the regulator. With a separate regulator, it had been the practice to enter separate inventory records for meter and regulator.

It was also found that meter testing and maintenance procedures were more thorough with the combination unit. In the case of the seven-year cycle as used by the Houston Natural Gas Corp., the usual practice is to inspect and maintain the regulator at the same time as the meter is tested and repaired. The time required to inspect both was found to be only slightly more than that required to inspect the meter alone.

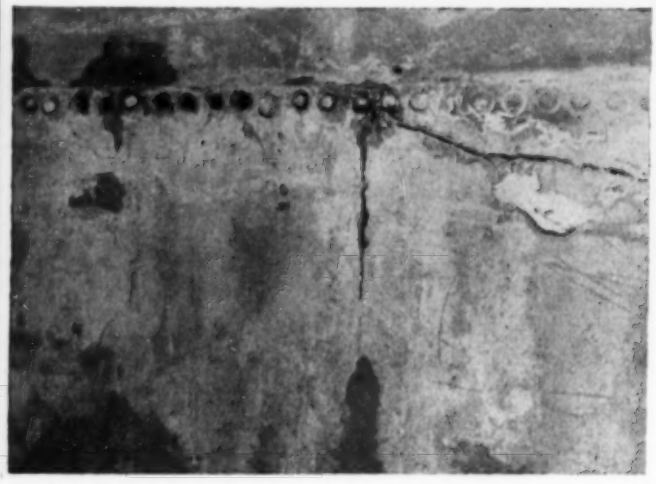


Fig. 1. Rivet and plate deterioration and stress corrosion on holder lift plates.

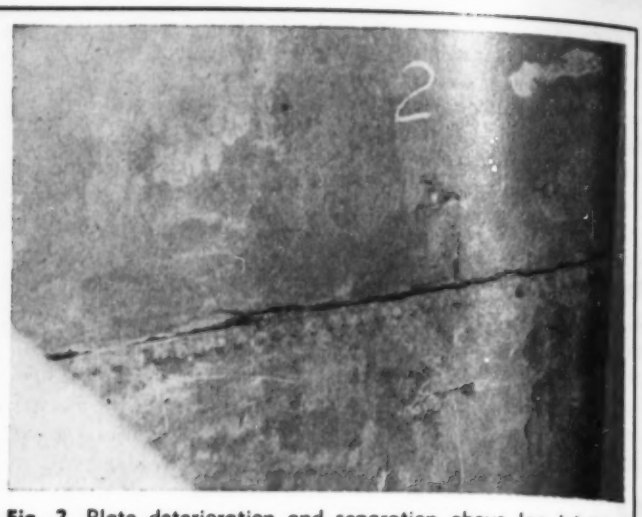


Fig. 2. Plate deterioration and separation above lap joint.

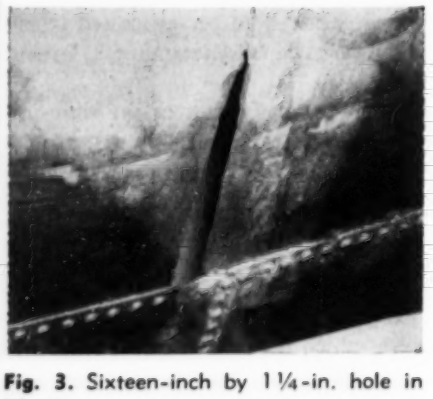


Fig. 3. Sixteen-inch by 1¼-in. hole in lift plate.

These evidences of deterioration necessitated a major plate repair job at Seattle Gas

IN THE summer of 1952, the Seattle Gas Co. was faced with a major problem—how to restore 100% capacity to the main plant's 2-MMcf storage holder, at lowest possible cost and with least interruption of plant operation.

In the lower hanging, lift rivets had disappeared, plates deteriorated, and long thin gashes appeared above some lap joints as though a cutting torch had been used. One sheet had a hole in the middle of it that measured fully 16 in. in length, averaging 1¼ in. wide (see *Figs. 1, 2, 3*). When the holder rose to nearly full height, this area of destruction proved too much for the water-seal and a foamy froth was spewed over the adjoining structure. The immediate control of this "devil's brew" necessitated restricting the holder capacity 10%.

Close examination of the leaks disclosed three important facts:

1. They were confined to the lower lift.
2. They were concentrated in an area centering on Column No. 8 on the southwest side. (See *Fig. 4.*)
3. They were contained within Sheets 40, 41, 42 and 43; with bottom hanging row 44 free of deterioration.

It had been assumed that the cause of these leaks was a straining of the shell brought about by the bottoming of the lift on some obstruction. But no evidence could be found of any buckling or strain which could have caused such a general deterioration of joints and rivets in this area.

Nevertheless, rivets *had* entirely disappeared, and other rivet heads were disintegrating. Edges of plates and corners of joints in some cases had been eaten away. In other places, thin gashes completely separated plates from lap joints for several feet. By far the worst failure was the 16-in. leak previously mentioned, which was located in the longitudinal center of a plate in Sheet 41, starting 3 in. over from the vertical lap joint in the next lower sheet (see *Fig. 3*).

Sheet 42 was also deteriorating in the same way, but had not progressed so far. A ragged slash was growing below the 16-in. hole which would some day take on the proportions of its neighbor. In the same area, pits in the sheets were found, ranging in size from a dime to a 50-cent piece, with nearly all of the 10-gauge plate gone in some cases.

A large percentage of the leakage, of course, resulted from lost and loose rivets permitting lap joint separation from intended gas pressure.

It was almost certain that such wholesale deterioration of the 10-gauge steel plate and rivets comprising the lift would have a discoverable cause. Simple oxidation was out, because (a) these plates had not been out of water for years; and (b) no rusting was detected. In fact, the edges of failures often were bright and clean looking, though some of the deterioration left a black, solid residue over the area of loss, very much like carbon of electrode quality, which could be cut and scraped with a knife.

Our conclusion was that at least some of the deterioration was caused by galvanic corrosion. We visualized a proc-

Badly corroded holder lift plates speedily restored by in-service repairs

By **M. C. McCALLUM** • Seattle (Wash.) Gas Co.

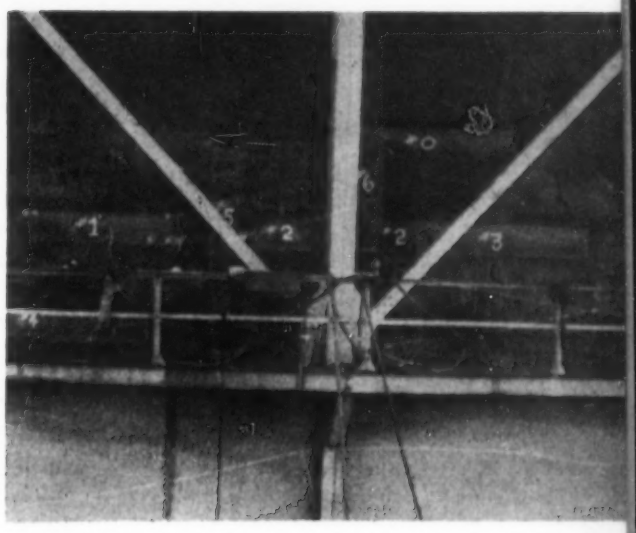


Fig. 4. Area of plate and rivet deterioration at Column 8 of holder.

ess similar to that which occurs in an ordinary flashlight battery, where two dissimilar metals, carbon and zinc, are held in an electrolyte. When they are connected by wire a current flows. As galvanic corrosion proceeds, the zinc case (anode) goes into solution and plates out hydrogen on the inner carbon. Eventually, pit holes appear through the case, and the battery is discarded.

In our case, assuming the steel plates of the lift in the affected area had a slightly different composition from the water tank plates, only the presence of ionized water in the tank was needed to provide the complete galvanic cell. Considering that the external circuit might well be completed from lift guide roller through vertical guide frame, securely riveted to the steel tank, we had a continuing corrosive action. Result—gradual destruction of the plate metal as described.

But why should this occur in one major area only? The answer might easily lie in the width of water body, or distance between holder lift and tank shell. Measurements of this water body, taken at each of the 14 vertical guide columns, were as shown at the bottom of page 42.

As the measurements show, the narrowest point is at Column 8, around which the corrosion area centered. This is logical, since the flow of electrons takes the path of least resistance.

Other areas indicating some corrosive attack were discovered at various spots around the lower lift at this same level. Each was opposite a 6-in. vertical guide channel, fixed to the inside of the tank for the purpose of guiding the bottom immersed roller of the lift. Being points of minimum distance between shell and tank, they would likewise be expected to show galvanic corrosion, similar to the large area at Column 8. However, an attempt to strengthen this theory by measuring the potential between the lift and the tank was unsuccessful. Results were so erratic as to defy interpretation.

The next step was—remedy.

Previously, a contracting firm had surveyed the problem and submitted a bid for the repair job. It involved purging the holder out of service, welding 12 new full-sized 10-gauge sheets and one patch into place, and then purging the holder back into service again. Estimate of time required for the entire operation was six to seven weeks, during which the Seattle Gas Co. would be without final gas storage space. Estimate of total cost was $21,000 minimum. This was considered prohibitive, both in cost and storage time lost, and the plan was abandoned.

In 1952, a steeplejack contractor, who thrives on unusual and difficult jobs, was consulted. He estimated that he could repair the damage for less than $1000, with no out-of-service time. He proposed hanging a patch of 14-gauge steel plate over the leaking area while it was submerged, bolting the upper edge to the lift shell with self-tapping screws, and working down the sides (under water if necessary) to fasten the plate as the lift was raised out of the tank. This plan was abandoned, however, because of difficulties of execution, in favor of one using several smaller patches.

Plates measuring 12 in. by 72 in. by 14 gauge were selected for ease of handling, and the lighter metal for easy fitting of joint contours. Each plate was punched 2 in. in from each edge, with 5/16-in. clearance holes for the ¼-in. self-tapping bolts, spaced 4 in. apart (see *Fig. 5*).

Successive attempts were made to stop the gas leaks before fastening on the steel patches, so that work could proceed without use of masks. Materials tried included a preparation of Portland cement and asphalt emulsion, asphalt-asbestos roofing mastic, and hot pitch. None were 100% successful.

The problem was finally solved with

Mr. McCallum, a University of Washington graduate in mechanical engineering, at present is in charge of the design and construction engineering division of Seattle Gas. He has been with the company since 1946. Prior to that time he had been associated with Westinghouse Electric, Rayonier Inc., Puget Sound Naval Shipyard and H. W. Beecher, consulting engineering firm.

Fig. 5. Attaching rubber-lined steel patches with self-tapping screws.

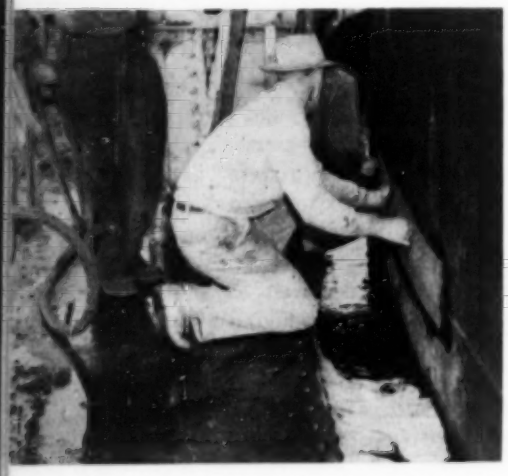


Fig. 6. First attempt to apply sponge rubber blanket. Better results were obtained by first applying blanket to the patch.

a ½-in. thick sponge rubber blanket under each 12-in. by 72-in. by 14-gauge steel plate, leaving a 2½-in. border all around the plate. At first, an attempt was made to apply the sponge rubber blanket to the holder sheet first, but the gas pressure would keep pushing the sponge blanket away and not let it get a complete firm grip. *Fig. 6* shows this first scheme being tried.

This problem was solved by applying a "3M" cement to both the steel patch and the rubber sponge and cementing these together. Then the surface of the repair area was thoroughly cleaned and cement applied to this and the other side of the sponge rubber blanket.

With the metal and rubber patch held firmly in place by hand, air drills were used to drill tap holes into the holder plates. Each hole was then filled with a ¼-in. self-tapping bolt, 1 in. long, driven home wtih an air wrench (see *Fig. 5*). Result was a metal patch whose edges were pulled down to meet the holder shell, in readiness for seal welding. When all corroded areas had been patched in this manner, and gas leakage reduced to a few stray bubbles issuing from bolt holes and plate edges, the welding started.

All bolt heads, plate edges and seams were seal-welded so that the patches became one with the lift-shell plating.

A special coated weld rod known as GE 6015W32 was used for this light-gauge work. A low hydrogen rod, it is soft and ductile, with excellent sticking power for welding of steels of unknown, or high sulfur, content. Using 110-v d.c. on reverse polarity, the welding proceeded smoothly and efficiently.

A water hose with a fine spray was kept in readiness for dousing the occasional gas flames caused by gas leaks igniting, but these actually caused little trouble.

A two-way phone communication system between the holder and the engine room exhauster made it possible to maintain steady positioning of the holder while repair work was going on.

Future corrosion anticipated

With the holder once more a gas-tight envelope, the problem of preventing further corrosion in the future was tackled. Since electrochemical or galvanic corrosion was suspected as the cause, the decision was made to install 14 zinc plates for anodic protection. These plates, 6 by 12 by ½ in., were drilled through at the midpoint for passing over a ½-in. stud welded to the lift shell, at the areas of incipient corrosion, and to the seven large patches near Column 8.

The back of each plate was brought up tight against the lift plate to make a good electrical contact, and thus a sacrificial anode was provided to protect the steel plating from further galvanic attack. Any galvanic potential, it is reasoned, will now be concentrated at these zinc anodes, since zinc is higher in the electromotive series than iron. The zinc ions will tend to go into solution ahead of the iron ions, thus drawing off the charge. This method has long been used successfully in marine service to protect ship hulls from the galvanic potential set up between bronze propeller and steel hull.

Weight and date of installation has been stamped on each zinc plate, so that future galvanic action can be carefully checked. Should time prove the plates inadequate for the job, another method of attachment of the sacrificial anodes, using zinc or magnesium rods will be tried. This method, suggested by Dr. A. L. Babb of the University of Washington's College of Chemical Engineering, would cover a much larger area.

As a final protective measure, the lifts were thoroughly scraped, and a coating of Garantol A applied by dip method to the dry metal surfaces. The faithful presence of this protective film should prevent the formation of oxygen cells, and reduce or eliminate the galvanic action by separating the metal from the electrolyte (water), in the tank seal.

Simple and sure method

The patching method used on Seattle Gas Co.'s 2 MMcf storage holder can be safely recommended as a simple and sure method of repairing both major and minor leaks. The prophylactic measures are still being field-tested, and the holder is under constant observation for any indications of success or failure of the method used.

On Oct. 26, 1953, inspection of the holder indicated no further corrosion of this nature either in the patched area or elsewhere, with one exception. A rivet leak on the north side had been plugged some years ago using an oversize sponge rubber patch held in place with a toggle bolt and large washer. The area under the overhanging surplus of rubber patch had not been reached by the liquid Garantol A, and as a result had corroded despite the presence of a zinc plate nearby. This is mentioned to emphasize that thorough coating with the liquid preservative is probably the best protection from galvanic corrosion.

At least, the holder has been restored to full use at a cost of less than $1000, and plant mechanics now pursue their tasks without fear of being confronted with the ominous hiss of gas making its bid for freedom in a cloak of "devil's brew."

Column Number...	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Meas. Width Inches.....	15½	16	16½	16	16½	16½	16	14	16	16	16	16¼	15	16

Ohio school goes all out for gas

A handy gas incinerator disposes of garbage and other waste material. Here one of the kitchen workers makes use of the incinerator in disposing refuse.

NATURAL gas plays a vital role in the operation of the Parma (Ohio) ultra-modern high school, built at a cost of $5 million.

It is used for cooking in the all-gas cafeteria kitchen, for cooking and refrigeration in the home economics classroom, for heating water for showers and wash rooms, and for driving engines that provide emergency sources of power.

As soon as possible natural gas will be used to heat the school.

"We're prepared to convert to gas as soon as restrictions are lifted and we can get it," explained Parma's school superintendent, Carl C. Byers.

The school now is heated by fuel oil. A gas boiler, however, is used to preheat the oil so that it flows properly into the school's furnaces. Until it is heated the oil is like molasses.

Why are school officials so sold on gas?

"Gas is more practical," Superintendent Byers stated. "There are things you can do with gas that you can't with other sources of energy."

Economy of operation—that's tremendously important to school people, too, Mr. Byers pointed out.

Taxpayers' money

"We're using the taxpayers money and we must show we're using it wisely and soundly," he said. "Gas is doing a good job for us."

In preparing plans for the new school the architects, Fulton, Krinsky and DelaMotte of Cleveland, specified gas for the various uses mentioned earlier.

The Ohio Fuel Gas Co. laid a 6-in. service line to the school building. Officials of the firm aided by explaining proper installation and use of the gas equipment.

A battery of Garland, heavy duty gas restaurant equipment with a cooking capacity of many burners, was placed in the kitchen of the cafeteria.

Taking full advantage of the efficiency and cleanliness of natural gas, school officials ordered all other major appliances installed in the kitchen to be gas fired.

Included in the all-gas kitchen was a 40-gal. Groen soup kettle, a huge, multi-tiered Blodgett bake oven, a steam cooker and steam tables. A steam-jacketed tilting kettle, used for cooking some vegetables, puddings and gravies, was installed, along with a large steam pressure cooker, also gas fired. Gas was also utilized to assure adequate steam and hot water for the dishwasher.

Fuel oil preheated

A Bryant gas boiler preheats fuel oil, which is fed into giant furnaces that keep the school warm. The fuel oil must be brought to 110° F before it will burn properly, yet it must not be heated to over 140°. Gas heat, thermostatically controlled, does the job.

Two 25-kilowatt generators serve as emergency units to provide light for the school in case of a power failure. These, too, are driven by natural gas.

Heating of water for showers and other purposes throughout the school is accomplished by the use of four Ruud multi-coil hot water heaters.

Gas incinerators are used to dispose of waste materials and garbage.

In the home economics classroom kitchen there is a Servel gas refrigerator and four modern gas ranges—an RCA Estate, Universal, Tappan, and Magic Chef—on which students practice cooking.

Today the student body of 1400 boys and girls enjoy the most modern school facilities in the state.

Gas range and refrigerator are center of attention as Ohio Fuel's "Betty Newton," Mrs. Jane Baugham, gives a demonstration before a home economics class. The home ec teacher, Miss Elizabeth Wilder, watches (right).

For rent: hot water

Haverhill Gas Light Co. has tapped the home-renter market with a highly successful water heater rental plan.

By **FRANK J. McLAUGHLIN** • Haverhill (Mass.) Gas Light Co.

WE have been engaged in the water heater rental program since June 22, 1953. That is a period of nearly nine months and the results which we have attained have been most gratifying. Those results, incidentally, have continued to grow.

The advent of natural gas in our area removed completely all restrictions to the sale of gas. Immediately load-building became the key-word of our operation. We realized that the sale of gas for space heating would provide us with a large increase in load in the shortest possible time. We also felt that we could add a very valuable load with a most attractive profit factor by increasing the saturation of automatic gas water heaters on our lines.

We made every effort to increase water heating sales through our own outlets and through local plumbing contractors, and were fairly successful. However, we realized that we were not reaching our greatest potential market: the home-renter, who was unwilling to purchase an automatic water heater, and the tenants of flats that were without hot water facilities.

We investigated several plans to promote automatic gas water heater sales that had been tried by other utilities such as long-term purchase plans, rental-purchase plans, and straight rental plans. It was decided that the straight rental plan would have the

Haverhill Gas Light Company

APPLIANCE LEASE AGREEMENT

Lease agreement dated ..... 19 ..... between Haverhill Gas Light Company, hereinafter called the "Company" and

NAME .....
PLEASE PRINT

STREET ADDRESS .....

CITY ..... STATE .....

hereinafter called the "Customer."

Customer hereby applies to and requests Company to lease to Customer a 30 gallon Gas Storage Water Heater (hereinafter called the "Appliance"), for domestic use at the above address.

Customer agrees to lease from Company and Company to lease to Customer said Appliance, subject to the terms and conditions hereinafter contained.

1. Installation shall be provided by a Master Plumber approved by the Company and the Company will assume installation charges not to exceed $..... Customer agrees to bear any installation charges in excess of such amount and to make payment therefore promptly upon receipt of a statement specifying such excess charges but in any event within 30 days after installation of the Appliance.
2. Company shall, at its expense, maintain such appliance in efficient operating condition.
3. Customer shall pay Company each month the sum of $..... for rental of such appliance. The rental charge shall be due and payable on the due date of the utility service bill for the above location.
4. Customer assumes all risk of loss or destruction of the appliance during the term of this lease and agrees to indemnify Company against any such loss or damage. Customer further agrees not to remove, transfer, tamper with, adjust or repair such appliance without permission of Company. Cost of moving or relocating appliance for Customer shall be at Customer's expense.
5. Company, without prejudice to any other claims it may have hereunder, may terminate this lease and enter Customer's premises and disconnect and remove the appliance, if one or more of the following conditions exists: (a) improper use of the appliance, (b) satisfactory operation is not reasonably possible, or (c) Customer fails to pay rental charges as provided herein within 30 days after the above-mentioned due date. Company's failure to terminate this lease by reason of any default of Customer shall not constitute a waiver of any other right Company may have against Customer because of such default, nor a waiver of any subsequent default.
6. Customer may terminate this agreement by thirty (30) days written notice to the Company or by discontinuing service, but in any event surrendering the appliance to the Company in the same condition the appliance was in at the time of installation, ordinary wear and tear excepted.
7. Customer agrees to notify Company of any sale or transfer of the premises above described, and to notify prospective purchaser that title to the appliance is in Haverhill Gas Light Company or its successor.

.....
Customer

HAVERHILL GAS LIGHT COMPANY

By: .....

LANDLORD'S CONSENT

The undersigned, owner of the premises referred to in the foregoing Agreement, hereby consents to the installation and use of the appliance referred to in such Agreement upon the conditions therein stated, including the right of Haverhill Gas Light Company to remove the same upon termination of said Agreement, it being the intent that such appliance remain the property of such Company at all times. It is further agreed that the present water heating equipment, if any, shall be set aside in such storage space as I may designate and Haverhill Gas Light Company will not be liable for any cost of reinstallation of said equipment upon termination of such Appliance Lease Agreement.

Dated: .....

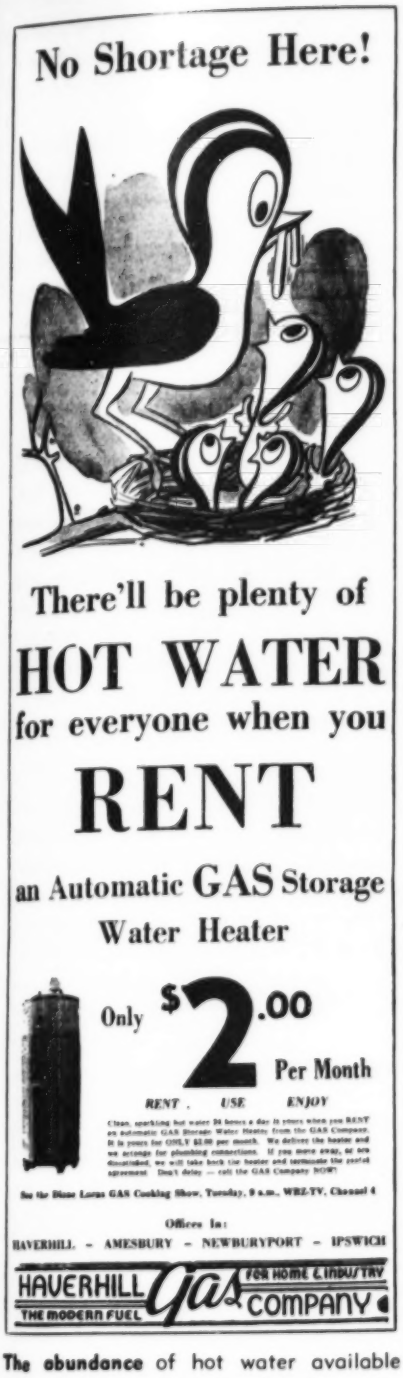
Owner .....

Street .....

City or Town .....

R.P. 4086

The water heater lease agreement used by Haverhill Gas Light Co.


No Shortage Here!
There'll be plenty of
HOT WATER
for everyone when you
RENT
an Automatic GAS Storage
Water Heater
Only $2.00 Per Month
RENT . USE . ENJOY
See the Diane Lucas GAS Cooking Show, Tuesday, 9 a.m., WBZ-TV, Channel 4
Offices In:
HAVERHILL - AMESBURY - NEWBURYPORT - IPSWICH
HAVERHILL Gas COMPANY
THE MODERN FUEL
FOR HOME & INDUSTRY

The abundance of hot water available with an automatic gas storage water heater was plugged in this ad, which is one of many used by the company.

greatest appeal to these customers. We felt that the word "rent" in our advertising program would have its greatest effect if it stood alone without the suggestion of any possible future obligation to purchase the equipment. Pride of ownership doesn't seem to extend to water heaters, out of the sight on the premises.

Having reached such a decision, we began to consider the problems facing us. What heater would we use? Who could rent a heater? How much of an installation should be subsidized? How much should we pay our salesmen? Should plumbers receive a commission on rental leads? How much would we charge?

Low-price heater selected

The condition of the water in our area permitted us to select a low-priced galvanized heater with a magnesium rod. We were fortunate enough to have available a galvanized heater that carried a 10-year replacement guarantee on the tank. We had several hundred of these heaters already in use on our lines and our results were most satisfactory. We elected to use only a 30-gal. heater for our rental program because that size heater best fitted the needs and conditions of the mass market which we were about to solicit. We decided to limit our rentals to domestic users only because we felt that any commercial enterprise which felt the need of renting a heater represented a credit risk which we didn't want to contemplate, and because we might encounter some unusual installation problem. In addition these accounts were prospective buyers and we didn't want to risk losing sales.

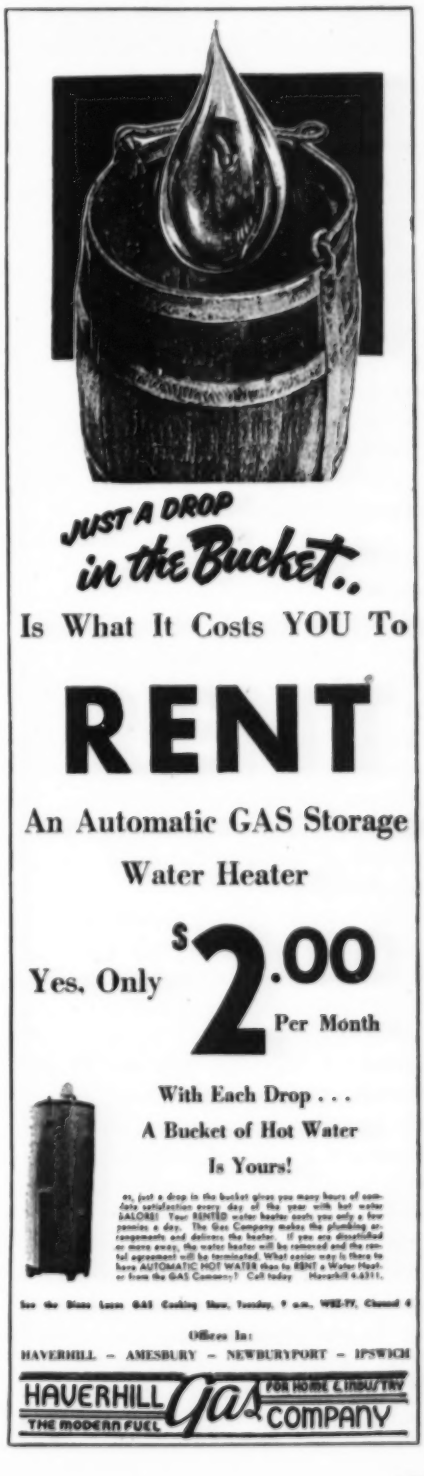
Installation problem

One of our biggest problems was the matter of installing rental heaters. We couldn't install them ourselves without impairing our plumber relations, which were excellent. Plumbers were selling gas storage water heaters for us and our own sales were on a delivered-only basis. We needed plumbers to install these heaters. The solution to our problem then was to arrive at a mutually agreeable maximum installation allowance which would be part of the rental agreement. Several meetings with the Master Plumbers Assn. resulted in an agreement that the company would allow installation charges up to $40 per rental heater, which sum would cover most installations. Any charge in excess of this amount would be billed, with the customer's consent as an ARJ charge due in 30 days. Without such consent, there could be no rental.

The approach that we used in arriving at this allowance was in effect this: "Gentlemen, we are seeking to sell a large segment of our market. These customers cannot or will not buy house piping from you because they do not own their own homes. We cannot sell them water heaters for the same reason but we can provide them with good automatic gas hot water service on a rental basis, but we need your cooperation. You cannot hope to crack this market. You have nothing to lose on our rental plan and you do have much to gain." Their reaction to this proposition was favorable.

We had decided before our initial contact with the plumbers that we would not pay a prospect fee for rental leads although we did pay and continue to pay 20% commission on water

This ad told the story of the rental plan from the low-price angle.


JUST A DROP
in the Bucket..
Is What It Costs YOU To
RENT
An Automatic GAS Storage
Water Heater
Yes, Only $2.00 Per Month
With Each Drop . . .
A Bucket of Hot Water
Is Yours!
See the Diane Lucas GAS Cooking Show, Tuesday, 9 a.m., WBZ-TV, Channel 4
Offices In:
HAVERHILL - AMESBURY - NEWBURYPORT - IPSWICH
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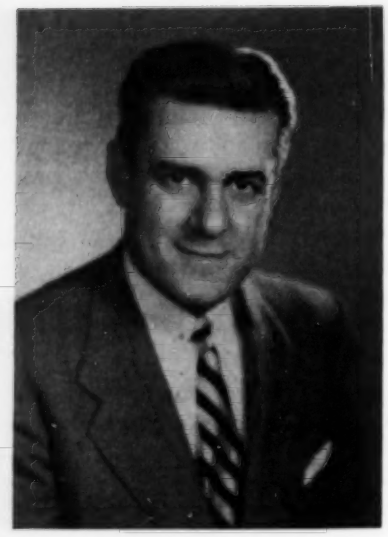

Mr. McLaughlin is general sales manager of Haverhill Gas Light Co.

heater sales made by plumbers. This idea was accepted by the plumbers.

It was planned that the rental water heaters would be completely installed by the plumber, including gas, flue and water connections and these gas and water connections would be made with unions. Failure to comply meant that the installation invoice would not be passed for payment.

Careful inspection

Each installation bill from a plumber was to be carefully itemized and equally well scrutinized. We would check rental installations against these bills for the purpose of avoiding any irregular charges for installations. The establishment of such a policing plan has been most effective in curbing any exorbitant tendencies and, in fact, we have lost very few rental opportunities because of excessive estimated costs of installation.

Our charge for the rental is $2 a month. We arrived at this figure because it permits us to write off the cost of the heater in seven years and amortize installation costs in the same period. At no time does the $2 ever provide an equity in the heater because we feel that eliminating the equity eliminates the idea of customer responsibility and makes our advertising and rental program most effective. At no time is there any obligation to buy.

The customer is required to sign a rental agreement form that stipulates the $2 monthly rental fee and a maximum installation allowance of $40. The $40 installation figure is included in the rental agreement because the customer must pay any charge in excess of that amount. The agreement also provides for the signature of the landlord authorizing the installation of a rental heater, acknowledging our title to the heater and providing us with no liability to re-install old water heating equipment in the event that the rental agreement is terminated. This is a most important phase of the agreement and cannot be emphasized too strongly. Occasionally a trustee of an estate will rewrite the landlord's consent paragraph to suit his thinking but we decline to accept any changes in the agreement.

Obstacles anticipated

One of the first obstacles that we anticipated upon embarking on a rental program was that our sales would deteriorate and result in decreased merchandise profit.

We have approximately 22,000 meters. During the first five months of 1953 we had sold 240 storage water heaters as against 167 for the corresponding period in 1952. On June 22 we embarked upon our rental venture. By Dec. 31, we had rented 362 heaters and had increased our sales to 545 for a total of 907 automatic gas storage water heaters added to our lines. Our total sales for 1952 amounted to 415 heaters. Our results then were an increase in sales of 130 heaters and a total increase of 492 heaters added to our lines.

At the outset I indicated that our rental program was designed to crack a market heretofore unapproachable. We have achieved that end. We have rented water heaters to many homes that had no hot water facilities. We have rented heaters to tenants who had side arm heaters, to persons who owned their own homes and who had a furnace coil, augmented in the summer months by a side arm heater, and we have rented heaters to replace tankless heaters. What's more the plan has brought many customers in to rent, who actually stayed to buy automatic water heaters.

We believe that our rental plan has not only developed the tenement market but has also opened other fields where a sales effort would be ineffective.

For the purpose of maintaining a record of rentals each heater is tagged with a metal device bearing a number and the notation "Property of the Haverhill Gas Light Co." This number is a company number and it is recorded with the manufacturer's serial number on the working copy of the rental agreement.

The entire cost of the water heater rental program is being financed through company funds, although we understand that several institutions will finance such plans. We also know that at least one manufacturer is willing to finance the purchase of water heaters for rental purposes.

We began our rental activity with newspaper advertisements and we continue to use them regularly. Since Jan. 1 we have been using a special postal solicitation to a selected mailing list. Some radio has been used. We have stressed in our advertising "Rent a water heater that will provide oceans of sparkling hot water with safe, dependable gas for only $2 per month." Inasmuch as most rentals are in tenement property, word-of-mouth advertising has proven to be a great asset.

Compensation plan

Under the terms of our salesman's compensation plan, we pay a commission of 7% on the delivered-only price of any water heater sold at retail and 3% on any water heater sold to a plumber or builder. In contrast to this we pay a flat $5 bonus on water heaters rented. The salesmen's reactions were most favorable. They describe it as the "nearest thing to a raise in pay they have ever received."

It is interesting to point out that as of Jan. 30 we have rented for the month 57 water heaters and have sold 32. This aggregates 89 water heaters for the month of January and indicates that our anticipated addition of 1200 heaters in 1954 may not be too far out of line.

We have been queried upon several occasions about what we do when tenants move away, leaving a rental heater behind. The first thing we do is to learn where they have moved to so that we may try to capture their water heating load at the new address. Secondly, we try to sell the already installed heater to the landlord on the grounds that the value of the property has been enhanced. Failing that, we try to rent the heater to the new tenant. Because of the relatively short time that we have been engaged in a rental program we have had no great experience in the matter of rental customers moving. Incidentally, we have taken back only one heater because of high operating cost.

This article has been adapted from a talk presented at the Feb. 5 sales manager conference of the NEGA.

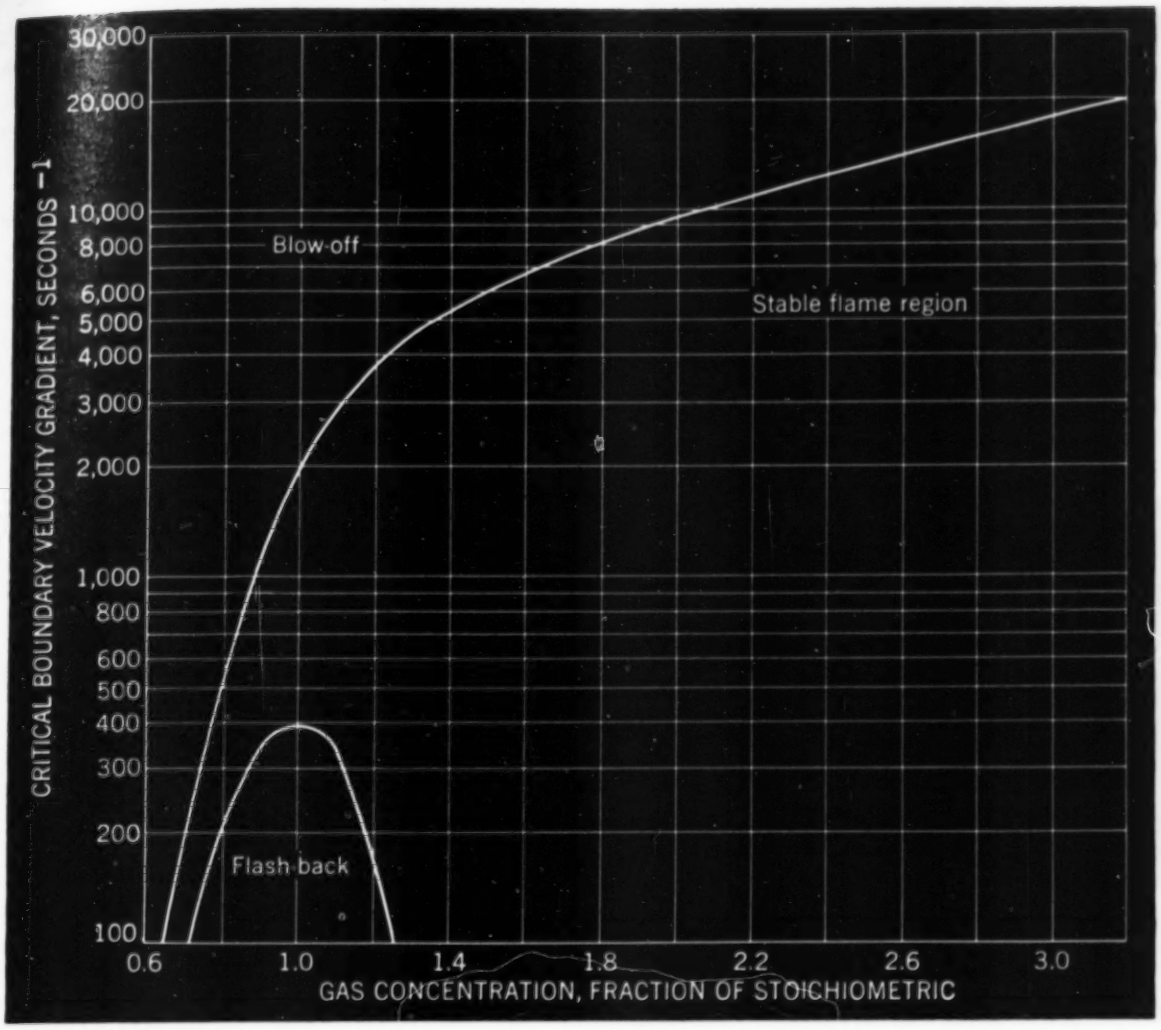

Fig. 1. Flame stability diagram for 100% methane.

New theories of gas-burning performance: calculating the old from the new

By **JOSEPH GRUMER** • Bureau of Mines, Pittsburgh

GAS burners are deceptively simple in appearance. This, coupled with the fact that gas burners were in use before the applicable scientific knowledge developed, has led to gas-making and burner-design practices that are highly developed arts more than sciences. Burners operating in appliances in homes and in factories are reputed to have different mystic ways of performing as compared to the same burners operating in free air on a test bench. It is safe to say that there are no gremlins in gas appliances—what is needed is an understanding of why and how events occur and information on the extent to which related physical parameters affect these events. The Bureau of Mines, through a cooperative agreement with the American Gas Association, has been carrying out a research program to supply part of the science of gas burner design and combustion characteristics of gases.*

This study illustrated by examples the utility of the Bureau of Mines curves of flashback and blow-off and the method of converting them to percent primary air versus Btu curves, which are the units familiar to the gas industry. We shall restrict ourselves to certain areas where we possess knowledge. The research is by no means complete. For the sake of simplicity, limitations of present theory will not be given here. They, as well as the theory, are discussed in the references listed.

Question 1: Can we separate the flashback and blow-off characteristics of a fuel gas from characteristics of the burner?

Answer 1: Theory enables us to do that, with certain exceptions, by use of a flame-stability diagram[2,4]. *Fig. 1* is such a diagram for pure methane. It

*This research is supported in part by the American Gas Association (Project PDC-3-GU).

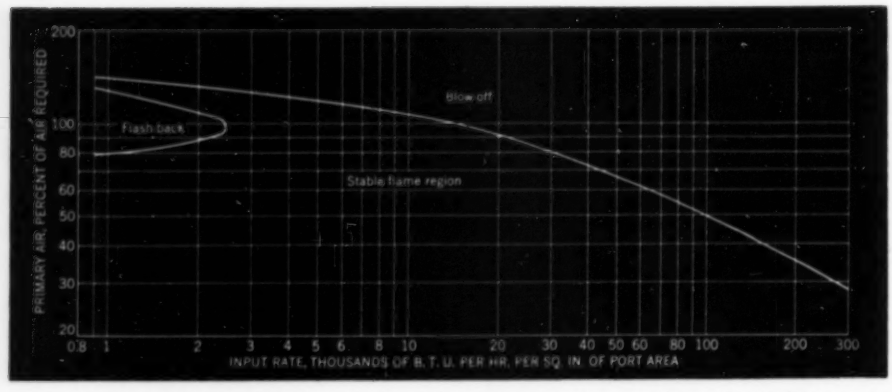

Fig. 2. AGA type of flashback and blow-off limit curves for methone for 0.25-in. port with steady laminar flow.

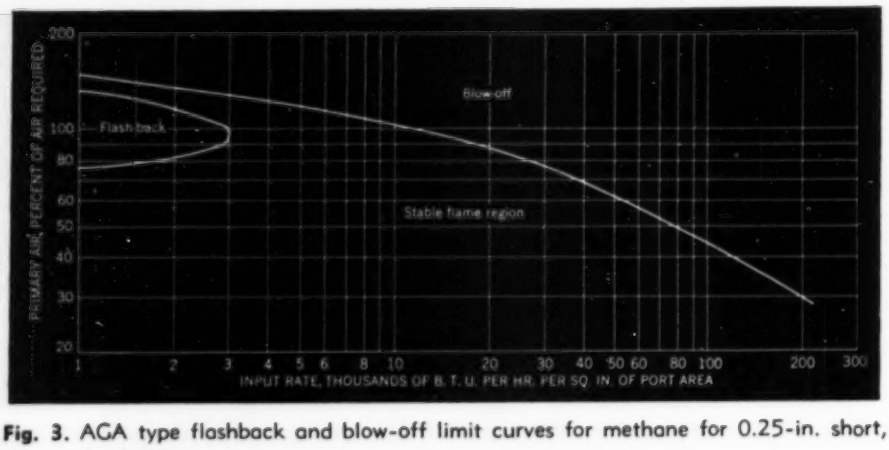

Fig. 3. AGA type flashback and blow-off limit curves for methane for 0.25-in. short, sharp-edged port.

contains two curves that demark three regions of flame behavior on burners —a region where flames flash back, one of stable flames, and one of blow-off. The diagram is characteristic of the fuel gas and correlates the flashback and blow-off limits of the fuel for all burners except for certain definable instances. The flame-stability diagram of any fuel can be determined experimentally in the laboratory with comparative ease. It can also be calculated with somewhat less accuracy from the body of data being assembled by the Bureau of Mines under a cooperative project with the AGA (Project PDC-3-GU, Study of Combustion Characteristics of Fuel Gases)[5].

The coordinates of a flame-stability diagram are new to the gas industry and bear definition. The boundary velocity gradient is the slope near the wall of the port of the curve of local stream velocity versus distance from the port wall. It can be calculated readily when the total flow and the flow profile near the wall of the port are known. Any flow through a burner port can be characterized by a value for the boundary velocity gradient. The word "critical" means that the particular boundary velocity gradient is for a flow at either the flashback limit or the blow-off limit. The symbol g is used for boundary velocity gradient, g_f for critical boundary velocity at flashback, and g_b is the critical boundary velocity gradient for blow-off. The abscissa of a flame-stability diagram is used to plot the relative amounts of fuel and primary air in the burner stream. The particular unit used is F, the fuel-gas concentration expressed as fraction of stoichiometric. F is the fuel-gas percentage divided by the stoichiometric percentage S for the fuel with air. Rich flames have fractions of stoichiometric greater than 1 and lean flames less than 1. The theoretical justification for the use of these diagrams and the units employed are given in references 2 and 4.

Question 2: Is the type of diagram in *Fig. 1* equivalent to the usual limit curves of the gas industry where Btu/hr in.^{2} is plotted against percent primary air?

Answer 2: No. There is a separate diagram for each burner port diameter when flashback and blow-off limits are plotted in the coordinate of Btu/hr in.^{2} (or Btu/hr); nor can we calculate limits in Btu/hr in.^{2} for another port diameter from a diagram as *Fig. 2* without using other concepts.

Question 3: How can we calculate the flashback and blow-off limits of a specific burner-port diameter in terms of Btu's versus percent primary air?

Answer 3: The abscissa of a flame-stability diagram F, fraction of stoichiometric, is used to calculate percent primary air, which is the ordinate of the AGA-type of diagram. The equation is

$$L = 100(1 - FS)/F(1 - S), \quad (1)$$

where

L = percent primary air, percent of air required stoichiometrically;

F = fuel-gas concentration, fraction of stoichiometric;

S = stoichiometric fuel-gas percentage divided by 100.

Incidentally, P, the volumes of air required for complete combustion of 1 volume of fuel, is

$$P = (1 - S)/S.$$

The ordinate of a flame-stability diagram g, the boundary velocity gradient (and also g_f and g_b, the critical boundary velocity gradient), is used to calculate M, Btu/hr in.^{2}, when port diameter D is specified. If the port is cold, held upright, and long enough to establish steady laminar flow, then M, Btu/hr in.^{2}, is equal to

$$M = 0.26\ ghDFS,$$

where

M = flow of fuel through the port, Btu/hr in.^{2};

g = boundary velocity gradient, seconds^{-1};

h = heating value, Btu per cu ft;

D = diameter of port, in.;

and incidentally

$$FS = 100/(LP + 100).$$

Let us go through an example where we will start with *Fig. 1* and calculate the flashback and blow-off curves in Btu/hr in.^{2} versus percent primary air for a cold, upright port (or ports) with steady laminar flow. The port diameter will be 0.25 in. Furthermore, if multiple ports are being considered, we will assume that these ports are far enough apart so that they have no effect on each other and that the flow through each port is the same.

Intercepts are read off the two curves in *Fig. 1*. Distinction is made between intercepts for flashback and those for

blow-off. This is done in the first and third columns of *Table 1*. Using equation 1, F, the fraction of stoichiometric, is converted to L, the percent primary air. These values are listed in column 2 of *Table 1*. For the first point listed (cf. *Table 2* for values of S and h),

$$L = 100\ [1 - 0.8\ (0.0946)]/0.8\ (1 - 0.0946) = 128. \quad (1.1)$$

Similarly, using equation 2, the gradients are changed into M, Btu/hr in.^{2} (for the 0.25-in.-diameter port). These values are in column 4. They pertain only to the ¼-in. port and not to any other port size. To get the values of M for another diameter, another diameter would have to be used for D. Again, for the first point listed,

$$M = 0.26\ (190)\ (1013)\ (0.25)\ (0.8)\ (0.0946) = 947. \quad (2.1)$$

When the newly calculated intercepts in columns 2 and 4 of *Table 1* are plotted, there is obtained the usual gas industry-type of limit-curves diagram. This is done in *Fig. 2*. (The yellow-tip limit is not part of this theory and must be considered separately. Work on the theory of yellow-tipping is in progress.)

Question 4: How can we calculate the flashback and blow-off limits of a drill port in terms of Btu/hr in.^{2} versus percent primary air?

Answer 4: The theory of critical boundary velocity gradients for flashback and blow-off applies in general[4] to all burner ports. Here we may note the ability of this theory to separate fuel-gas characteristics from burner characteristics. The flame-stability diagram for a fuel is for the fuel on all burners[4], but the equations for converting port loading into g, or g into port loading, depend upon burner factors, such as port depth, port shape, and so forth[6, 9, 10]. We cannot as yet with our present fund of knowledge, consider all burner-port-design factors that appear in practice. However, for a drill port that is cold, held upright, circular, short and sharp edged,

$$\log M = 0.8621 \log g + \log h + 0.7241 \log D + \log S + \log F + 0.1379 \log (\eta/\rho) - 0.2063 \quad (2a)$$

where

η = viscosity, poise;

ρ = density, grams per cubic centimeter.

We are also specifying in equation 2a that certain friction coefficients[1, 6] are of the class pertaining to methane and that the port diameter be known (0.25 in.). The equation converting F into L is still equation 1, since the relationship between L and F depends upon fuel factors only. Again, intercepts are read off *Fig. 1*, since we are dealing with methane. These intercepts are listed in columns 1 and 3 of *Table 3*. The corresponding values for L are in column 2. The values for M calcu-

TABLE 1. Converting the flame-stability diagram of methane to limit curves for a 0.25-in. port burner with steady laminar flow.

F	L	g	M
		Flashback	
0.8	128	190	9.47
.9	112	330	1,850
1.0	100	390	2,424
1.1	90	340	2,322
1.2	82	180	1,336
		Blow-off	
0.8	128	510	2,529
1.0	100	1,950	12,122
1.2	82	3,750	27,843
1.6	59	6,800	67,192
2.0	45	9,500	117,560
2.4	36	12,500	184,579
2.8	29	16,200	281,614

TABLE 2. Composition of fuel gases.

Analysis	Methane	Oil Gas No. 1
CH_4, percent	100.0	37.4
C_2H_4, percent	—	33.4
N_2, percent	—	14.0
H_2, percent	—	15.2
Specify gravity	0.555	0.68
Stoichiometric fuel gas, percent/100	0.0946	0.103
Gasline pressure	same for both	
Heating value, Btu/cu ft	1013	966
Stoichiometric volumes of air	9.57	8.75

TABLE 3. Converting the flame-stability diagram of methane to limit curves for a 0.25-in. short, sharp-edged port burner.

F	L	g	M
		Flashback	
0.8	128	190	1,258
.9	112	330	2,290
1.0	100	390	2,915
1.1	90	340	2,850
1.2	82	180	1,825
		Blow-off	
0.8	128	510	2,930
1.0	100	1,950	11,700
1.2	82	3,750	24,500
1.6	59	6,800	54,300
2.0	45	9,500	91,000
2.4	36	12,500	138,000
2.8	29	16,200	200,500

TABLE 4. Converting a performance curve for burners adjusted on methane to the performance curve for the same burners on substitute oil gas No. 1 and to the adjustment curve for a 0.25-in. port burner with steady laminar flow on substitute oil gas No. 1.

F_a	F_x	g_a	g_x	L_x	M_x
1.28	1.05	4,200	4,150	95	28,193
1.36	1.12	1,650	1,634	88	11,840
1.4	1.15	1,050	1,040	86	7,738
1.56	1.28	590	584	75	4,836
1.8	1.48	465	457	64	4,376

Calculation for the first point in Table 3 (at left)

$$\emptyset = \frac{(1.28)^2\ (0.0946)^2\ (0.555)}{(0.103)^2\ (0.680)\ [1 - (1 - 0.555)\ (1.28\ (0.0946)\ ]} = 1.14. \quad (3.1)$$

$$F^2_x + 1.14\ [(1 - 0.680)\ 0.103]\ F_x - 1.14 = 0.$$

$$F^2_x + 0.0376\ F_x - 1.14 = 0.$$

$$F_x = \frac{-0.0376 \pm \sqrt{(0.0376^2 - 4\ (-11.14}}{2} = +1.05.$$

$$g^2_x = (4200)^2 \frac{[1 - (1 - 0.555)\ 1.28\ (0.0946)\ ]}{[1 - (1 - 0.680)\ 1.05\ (0.103)\ ]}. \quad (4.1)$$

$$g_x = 4150.$$

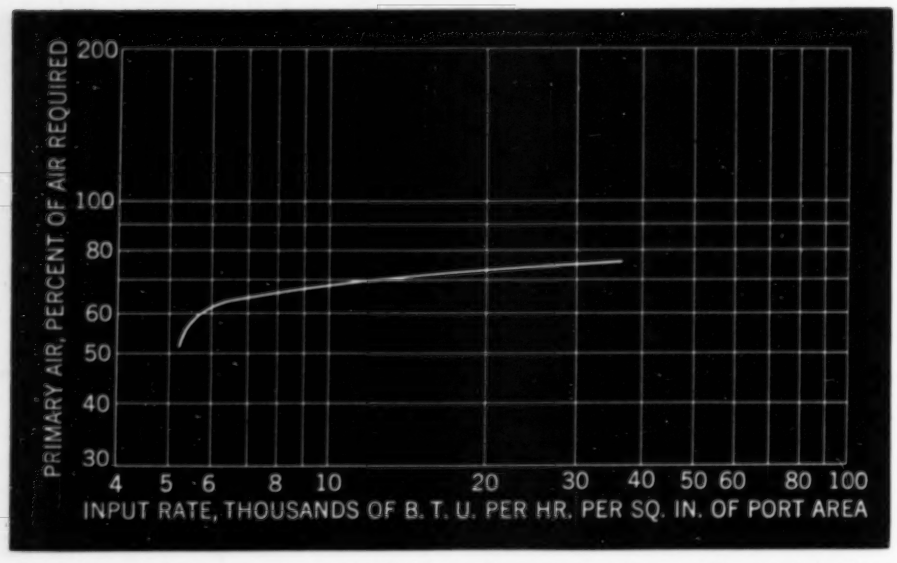
PRIMARY AIR, PERCENT OF AIR REQUIRED
200
100
80
60
50
40
30
4 5 6 8 10 20 30 40 50 60 80 100
INPUT RATE, THOUSANDS OF B. T. U. PER HR. PER SQ. IN. OF PORT AREA

Fig. 4. Assumed adjustment curve for 0.25-in.-diameter port burner with steady laminar flow adjusted on methane.

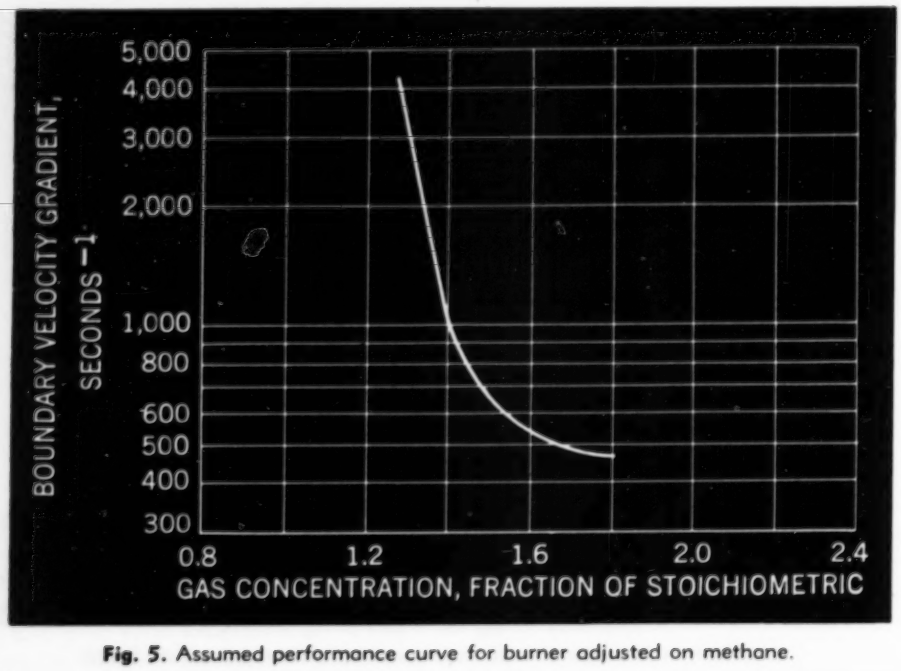

Fig. 5. Assumed performance curve for burner adjusted on methane.

lated by equation 2a are in column 4. For the first point listed,

$$\log M = 0.8621\ (2.2788) + 3.0056 + 0.7241\ (9.3979 - 10) + 8.9759 - 10 + 9.9031 - 10 + 0.1379\ (9.2183 - 10) - 0.2063. \quad (2a.1)$$

$$M = \text{antilog } 3.0991 = 1258.$$

The resultant diagram is given in *Fig. 3***.

Question 5: How can we calculate the exchangeability of fuel gases on a particular burner in terms of Btu versus percent primary air using flame-stability diagrams?

Answer 5: In *Fig. 4* we have an assumed adjustment curve for a 0.25-in.-diameter port burner on methane for steady laminar flow. In *Fig. 5* we have the corresponding Bureau of Mines performance curve. One can go from one to the other by means of equations 1 and 2. These are not limit curves but curves of air entrainment. By adding the limit of curves of *Fig. 2* to *Fig. 4*, and *Fig. 1* to *Fig. 5*, one could show the position of the adjustment or performance curve in relation to the flashback and blow-off limits of methane, the adjustment gas. But we need not do this in answer to question 5.

We start with the intercepts of the curve in *Fig. 5* (columns 1 and 3 of *Table 3*) and calculate the performance curve for the substitute gas, using equations 3 and 4***[2,3,7,8].

$$F^2_x + \emptyset\ [(1-d_o)S]_x\ F_x - \emptyset = 0, \quad (3)$$

where

$$\emptyset = \frac{[F^2\ S^2\ d_o]_a}{[S^2\ d_o]_x\ [1 - (1 - d_o)FS]_a}$$

$$g^2_x = g^2_a \frac{[p_o/_1 - (1 - d_o)FS]_x}{[p_o/_1 - (1 - d_o)FS]_a}, \quad (4)$$

where

d_o = specific gravity of fuel gas; and

p_o = fuel gasline pressure.

Subscript *a* designates fuel gas used for adjusting burner, and subscript *x* designates new fuel gas. The substitute gas will be an oil gas of the composition listed in *Table 2*. The calculation for the first point in *Table 3* is shown at the end of the table [assume $(p_o)_x/(p_o)_a = 1$].

The resulting curve (columns 2 and 4 of *Table 4* and the performance curve in *Fig. 6*) is the performance curve for this burner, on the substitute oil gas No. 1. The other two curves in *Fig. 6* are the curves of the flame-stability diagram of oil gas No. 1 (see first paragraph of answer 1). It is immediately obvious from *Fig. 6* that there is a region where our burner is in flashback. To that extent, oil gas No. 1 is not exchangeable on our burner adjusted on methane.

The adjustment curve for our burner on the substitute oil gas No. 1 is obtained by placing the intercepts of the performance curve (columns 2 and 4 of *Table 4*) into equations 1 and 2 and solving for L and M. This is done in columns 5 and 6 of *Table 4*. For the first point listed,

**Comparing *Figs. 2* and *3* will not establish which type of port has a better stability range. Other considerations are required for answering that question[6].

***As generally happens, when the ratio of $1 - (1 - d_o)S$ for both fuels is within 5% of unity, equations 3 and 4 may be replaced by equations 3a and 4a:

$$F_x = F_a \frac{S_a(d_o{}^{1/2})_a}{S_x(d_o{}^{1/2})_x}, \quad (3a)$$

$$g_x = g_a \frac{(p_o{}^{1/2})_x}{(p_o{}^{1/2})_a}. \quad (4a)$$

Correspondingly, then,

$$L_x = \frac{L_a\ P_a(d_o{}^{1/2})_x + 100(d_o{}^{1/2})_x - 100(d_o{}^{1/2})_a}{P_x(d_o{}^{1/2})_a}. \quad (5)$$

$$M_x = M_a \frac{h_x}{h_a} \frac{(p_o/d_o)_x{}^{1/2}}{(p_o/d_o)_a{}^{1/2}}. \quad (6)$$

$h/d_o{}^{1/2}$ of equation 6 is the well-known "input-rate factor" of gas-industry literature. However, the "primary air factor" in general use today, $d_o{}^{1/2}/h$, is not substantiated by equation 5. The primary air factor, $d_o{}^{1/2}/h$, does not correctly relate changes in percent primary air when fuel gases are exchanged.

Nomenclature

d = specific gravity;

g = boundary velocity gradient, seconds^{-1};

h = heating value of fuel, Btu/cubic foot;

p = static pressure head, centimeters of water;

D = diameter of port, inches;

F = fuel gas concentration, fraction of stoichiometric;

L = percent primary air, percent of air required stoichiometrically;

M = flow of fuel through port, Btu/hr, inches^2;

P = volumes of air required stoichiometrically for 1 volume of fuel;

S = stoichiometric fuel gas percentage/100;

η = viscosity, poise;

ρ = density, grams per cubic centimeter.

Subscripts

None = mixture of fuel gas and primary air;

a = fuel gas used to adjust burner;

o = fuel gas;

x = substitute fuel gas;

B = blow-off limit;

F = flashback limit.

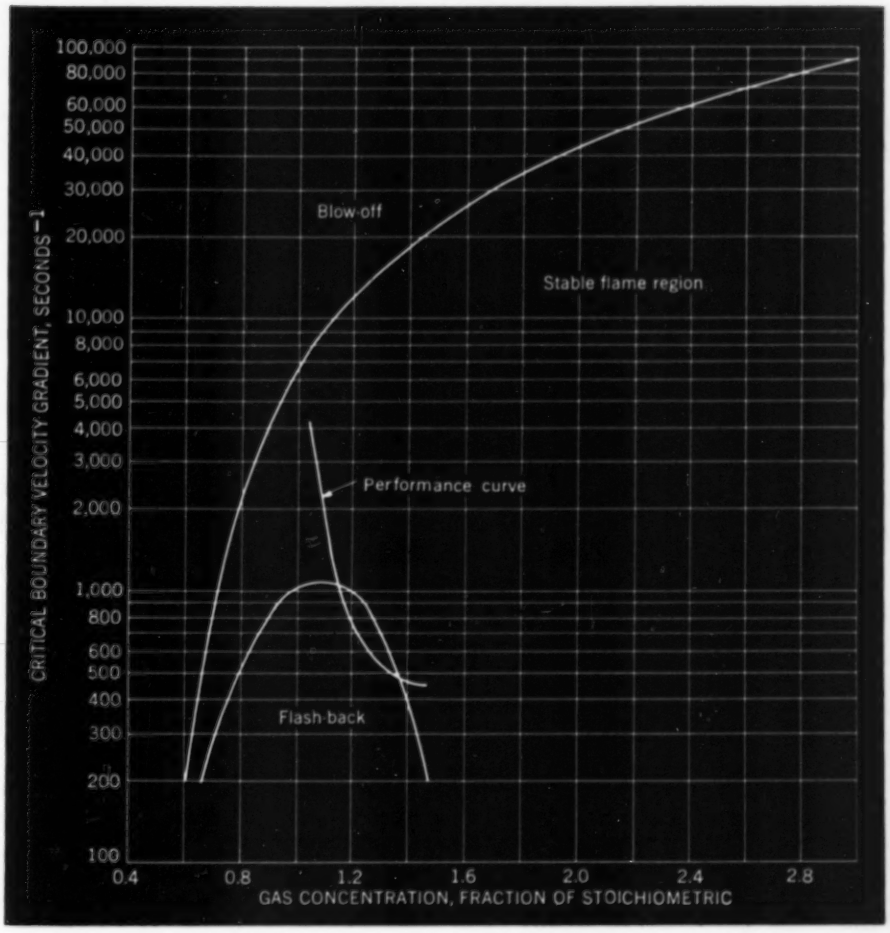

Fig. 6. Comparison of a performance curve with the flame stability diagram for oil-gas No. 1.

$$L = 100\frac{[1 - 1.05\ (0.103)]}{1.05\ (1 - 0.103)}. \qquad (1.2)$$

$$M = 0.26\ (4150)\ (966)\ (0.25)\ (1.05)\ (0.103) = 28{,}193. \qquad (2.2)$$

Last, we need to compare the adjustment curve on the substitute gas with the limit curves of that burner on the substitute gas. These are obtained for oil gas No. 1 from the flame-stability curves of oil gas No. 1 as given in *Fig. 6* and equations 1 and 2. The procedure followed is that in answer 3. The resulting diagram is *Fig. 7*. From it, we draw the same conclusions as from *Fig. 6*, but in units that are familiar in the gas industry.

Some uses of Bureau of Mines theories of burner performance and combustion characteristics of fuel gases have been illustrated here. The evidence substantiating these theories is already in the literature. The approach is different in that an understanding of the physical and chemical nature of processes is sought rather than empirical answers. Characteristics of fuel gases are to be separated from characteristics of burners, and these are to be separated from characteristic of environment. A large body of information has been gathered but there is still a large body to be obtained.

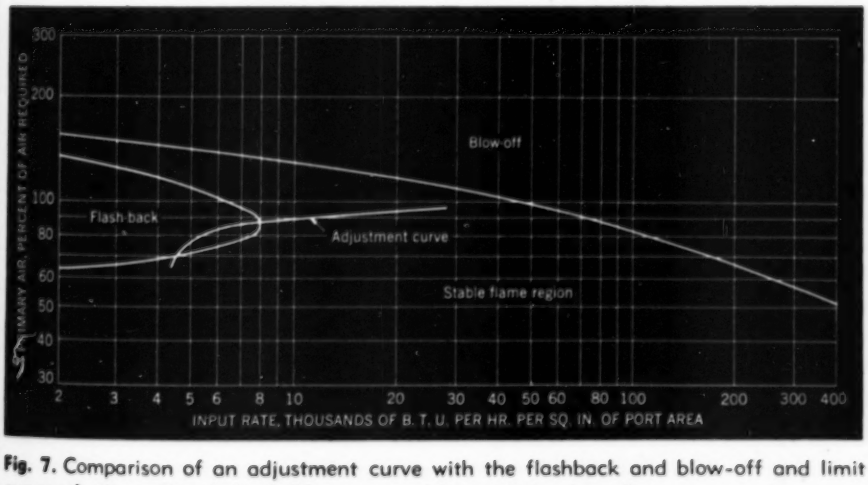

Fig. 7. Comparison of an adjustment curve with the flashback and blow-off and limit curves of oil-gas No. 1 for 0.25-in. port with steady laminar flow.

Acknowledgment

The author wishes to thank Miss Margaret E. Harris of the Bureau of Mines for her cooperation in preparing this study.

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Turning a good bet into a sure thing

Management development program builds tomorrow's leadership at Con Edison

Top management, more than ever before, is showing a healthy concern over the problem of replacing itself. Preparing younger men to be tomorrow's vice presidents is a process that is no longer hit-or-miss, but is rapidly becoming more systematized. The newer approaches are not coldly scientific, but are conducted on a personalized basis that seeks out, and brings out, the best in tomorrow's potential leaders.

The philosophy is still developmental. Management continues to ask itself what qualities make a leader, before and after the fact. This searching is reflected in the Columbia University Utility Management Workshop, discussed in last month's issue (pages 39-41).

Here is a story of how one company is ferreting out tomorrow's leaders from the ranks. With Consolidated Edison, the problem is magnified by the extreme size of the company. The top echelon is selected from many thousands of employees. Companies without such a formal program could do worse than pattern their procedures after ConEd's.

SOME people say executives are made, not born. Others maintain they are born, not made. You can pay your money and take your choice, but when you have a billion-and-a-half-dollar business to run you don't take chances.

Maybe executives are made, in which case Consolidated Edison is doing its best to make them. And, since they may also be born, it is leaving no stone unturned to find them.

Playing it safe, Con Edison has a management development program that pursues both objectives simultaneously. It molds men into future executives by broadening their experience and increasing their growth potential. At the same time it is a sort of managerial-caliber detecting device that enables today's management to seek out its most likely successors.

Identifying and developing future leaders for all management levels is not a new experience at Con Edison. The management development program started in 1943 as the executive development program. The name was changed last year and minor administrative changes have been made. But its over-all concept and mechanics, proved effective, remain the same. The objective is the same, too.

If you want to dabble in semantics you can say the new name is more appropriate, more consonant with the program's over-all intent to create the best possible management team—up and down the line and across the board. Viewed in its entirety, management includes but is not limited to the exercise of executive powers. And Con Edison is concerned with developing good management from the overall supervisor to the man behind the mahogany desk.

Results are what count and those of Con Edison's management development program speak for themselves. A close inspection of the company's organization charts offers a clear clue to the program's success.

An increasing percentage of the names on those charts belong to management development program graduates. Already they hold many positions up and down the managerial scale. Any lingering doubts about the program's value are dispelled with every new promotion.

The man who directs the program is one of its alumnae. He is Mowton LeCompte Waring, vice president for operation and production, and a good case history. In 1945 he returned from military service a division engineer, one of Con Edison's promising younger men. He served a tour on the executive development program, as it was then called; and by 1949 he was an assistant vice president. He became a vice president last year at the age of 46.

Con Edison doesn't expect all its management development program graduates to become vice presidents. But some of them will. It is inevitable. There are many promising men in the company. Every large corporation has its share. Unfortunately, they are sometimes tucked away in a remote corner. Sometimes they are discovered, sometimes not. Yet the potential is there.

This element of chance is eliminated by the management development program. As Mr. Waring says: "We want to be darn sure we don't miss any good bets. Our search for talented, promising men is a continuing process. What's more, we look for them where they are

This is the second appearance in GAS of Norman Johnson, a member of Consolidated Edison's public information staff. Mr. Johnson's story describing how employees participate in ConEd's television show appeared in November 1953 ("They're Telling the World About Their Jobs," pages 31-32).

Drawings are by Ed Konow, cartoonist for the company's employee publication, "Around the System." His distinctive style, as evidenced in a regular-feature comic strip, "The Metro Family," is a trade mark of the magazine.

most likely to be found—right in our own backyard. And when we find them we give them every opportunity to prove their stuff. In fact, we create that opportunity."

Con Edison started its management development program in 1943 to solve a definite management replacement problem. An abnormally large number of management people at all levels were approaching retirement age and heavy losses were forecast over a period of about 10 years beginning in the mid 1940's. After that the loss rate, personnel studies showed, would taper down, gradually assuming more normal proportions.

You might say Con Edison's past was chatching up with it. It became top-heavy with older employees, many at high experience levels, because of the way it grew as various New York City utilities were merged into a single, unified gas and electric system. The company's name today—*Consolidated* Edison—reflects this evolutionary process.

As these mergers occurred, employees of the separate companies were absorbed and large, single functional groups evolved where there formerly were many. There was no managerial shortage then. The growing company probably had more managers, assistant managers, assistant-assistant managers and supervisors than it could use. And there were plenty of other experienced men ready, willing and able to step into any empty shoes.

That was the period of feast and plenty; but there was famine in the offing and Con Edison management, looking ahead, was not disposed to play the role of an improvident Aesopian grasshopper, singing away the summer hours instead of filling its larder.

Something had to be done to prepare for heavy personnel losses that would at once thin management ranks and tax normal promotion and replacement procedures, as younger men would have to be advanced into vacancies at an unusually fast clip. There wouldn't be time then to move cautiously, or build up a new team gradually, so it would have to be done beforehand.

The plan devised for the emergency was the management development program. Its success is a matter of record and it is now a permanent company procedure.

The basic feature of the program is job rotation, a method already attempted with good results in the early 1930's on a smaller scale when supervisory employees in operating departments of several recently merged electric companies had been assigned to different jobs.

As now applied, however, job-rotation is undertaken on a higher plane, across a wider latitude. Personnel are successfully interchanged among Con Edison's major functions—engineering, production, operation, sales, customer relations, purchasing, industrial relations, finance, and public relations.

Each participant is assigned new jobs in different functions at levels commensurate with his ability, background, education and, generally speaking, along those lines that will benefit him most.

Although each succeeding assignment is different, the man assigned to the job assumes the responsibility that goes with it. He is not an observer, merely watching over someone else's shoulder to see how it is done.

Assignments on the management development program usually last three years. But this is flexible; the length of the tour depends entirely on the individual situation. Generally, each assignment lasts a year or less.

A tour on the program is an education of itself. During this time a man is exposed to new environments and experiences, confronted with new situations to cope with, new problems to solve. He works with different people, gets to know them; and they get to know him. When he's through he has assimiliated a broader knowledge of company operations and has learned to appreciate the interrelation of some of its diversified functions.

When a man is lifted out of a department where he may have spent all, or most of his company career and given a series of new assignments, he discovers other horizons on which to set his sights. The isolationary wall that present-day emphasis on technical specialties tends to erect is battered down. He may have thought of greener pastures; now he has a chance to graze on them awhile without risk. Whatever he does in the future, the experience he obtains on the program will serve him well.

Nor are the benefits one-sided. The company profits as much as the individual. In fact, it harvests the sum total of each man's personal gain. Running a business is not a one-man show. How well it is run depends on the quality of all its component human parts. To improve the quality of the components improves the company as a whole.

Consolidated Edison's management development program panel in session. This group, comprising men at various levels of management representing different company functions, is the program's coordinating agency. Mowton L. Waring, vice president for production and operation, top company official directly concerned with the program's implementation, is at the head of the table.

Day-to-day practical experience derived from assignment to different jobs is supplemented by extra-curricular activities, in and outside the company.

Men on the management development program meet periodically at luncheon sessions to exchange ideas, swap experiences, and get to know each other. They participate in industrial relations work and act as instructors on employee training programs.

Outside the company they attend meetings of various professional societies and utility industry groups, such as the American Gas Association, Edison Electric Institute, American Management Association and others. Some do graduate work, or even teach, at local colleges and universities.

The management development pro-

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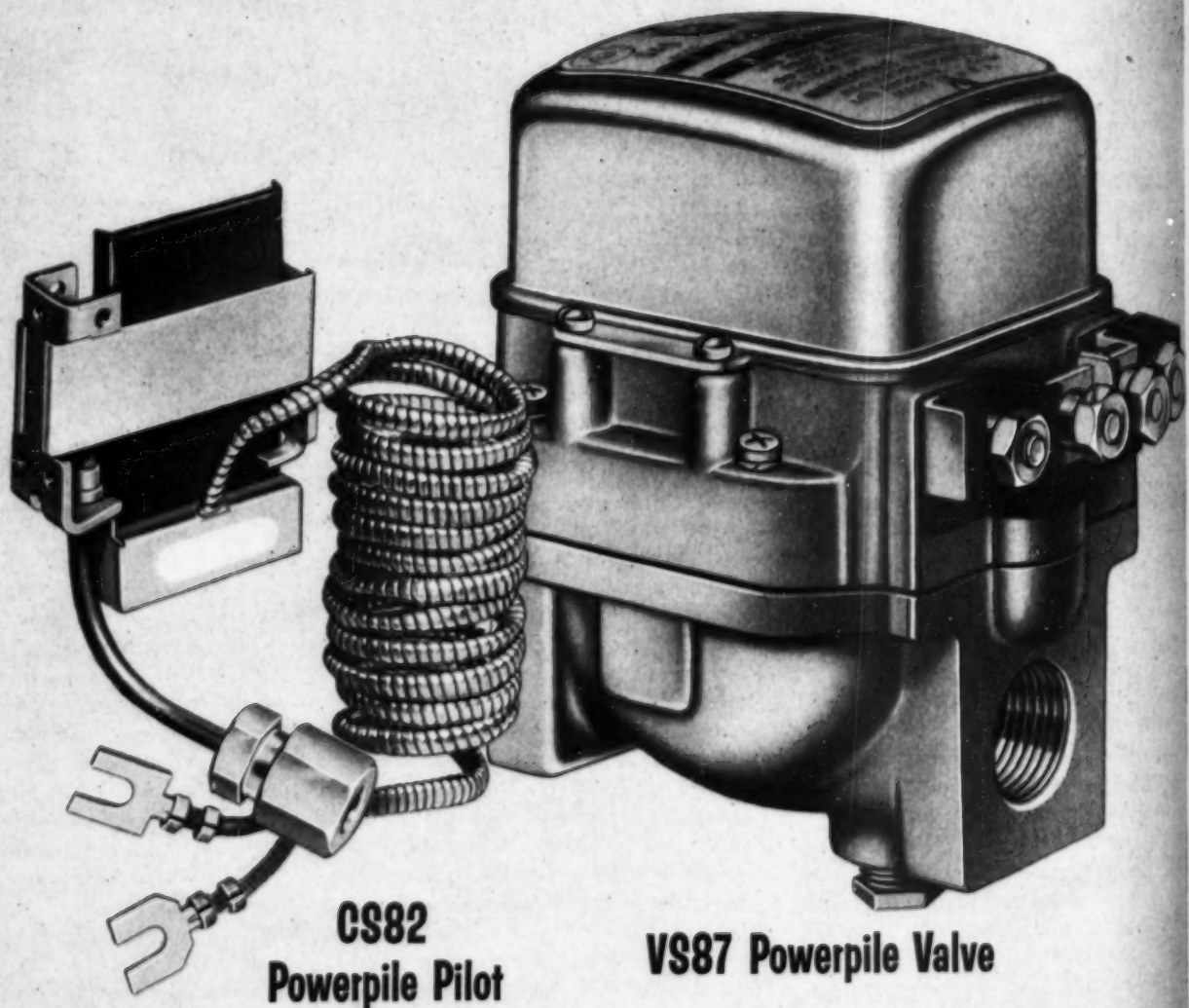
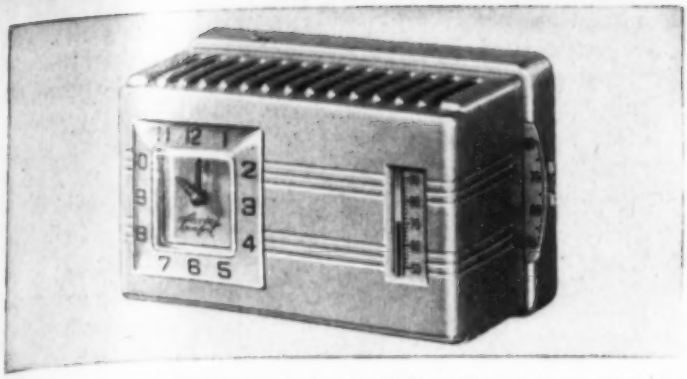
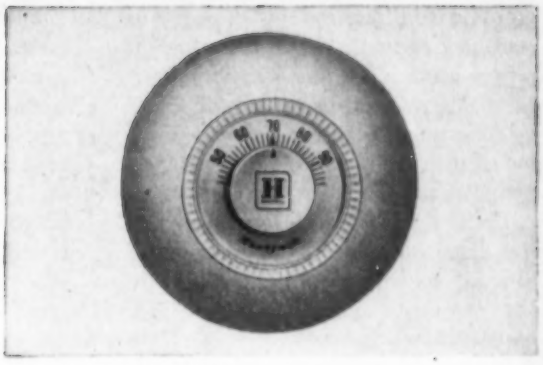


CS82
Powerpile Pilot

VS87 Powerpile Valve



Y400D Powerpile Package includes the TM850 Chronotherm which has the famous electric clock that *automatically* turns the heat down at night ...and raises it again in the morning for 24-hour comfort control.



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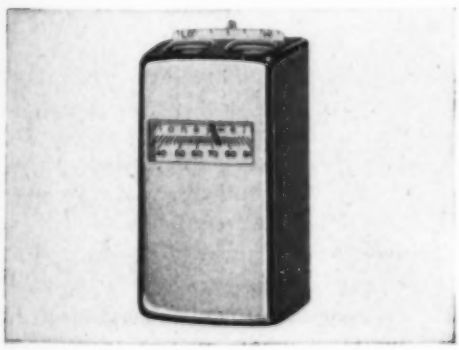
Y400B Powerpile Package includes the T804B Thermostat with mercury switch—a built-in "cycler" smooths out temperature fluctuations.



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104 OFFICES ACROSS THE NATION

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gram is administered by a panel of seasoned members of management representing all major company functions. They screen nominees suggested by department heads, and closely monitor each man's progress while he is on the program.

Both the individual concerned and the department head who nominated him are consulted on matters pertaining to a man's assignment to the program. It is a personalized operation throughout, and each situation is judged individually. Everyone with a stake in it contributes to its success.

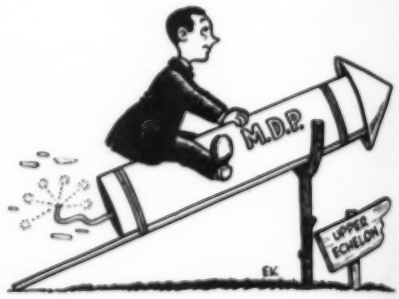
Flexibility and informality guide program planning and administration. And the panel itself bends over backwards to avoid becoming arbitrary or rule-bound. Red tape was tossed aside long ago, which, according to Mr. Waring, is one good reason why the program has worked so well.

He puts it this way: "We have a representative panel running this program. We like to think of it as a coordinating agency which sifts, studies and evaluates all the facts that pertain to a man's assignment to the program.

"Though the panel makes important decisions—such as how long a man will stay on the program, whether he should be there at all, and where he should be assigned—on which a man's career may depend, we don't consider that it has any God-given authority to act arbitrarily. Nor does it rely only on itself; it seeks out information, advice and opinions from others as well."

A prejudice that had to be overcome at the outset was the individual's apprehension that he might miss out on promotions and raises while away from his home base. This was overcome by one of the program's few set rules which is that, at a minimum, a man must make out as well financially while on the program as if he were still in his old department. In practice most men on the program make out better financially. They wouldn't be there if they were deadheads; and merit, after all, has its rewards.

One of the few changes made in the past 10 years has been to shorten the

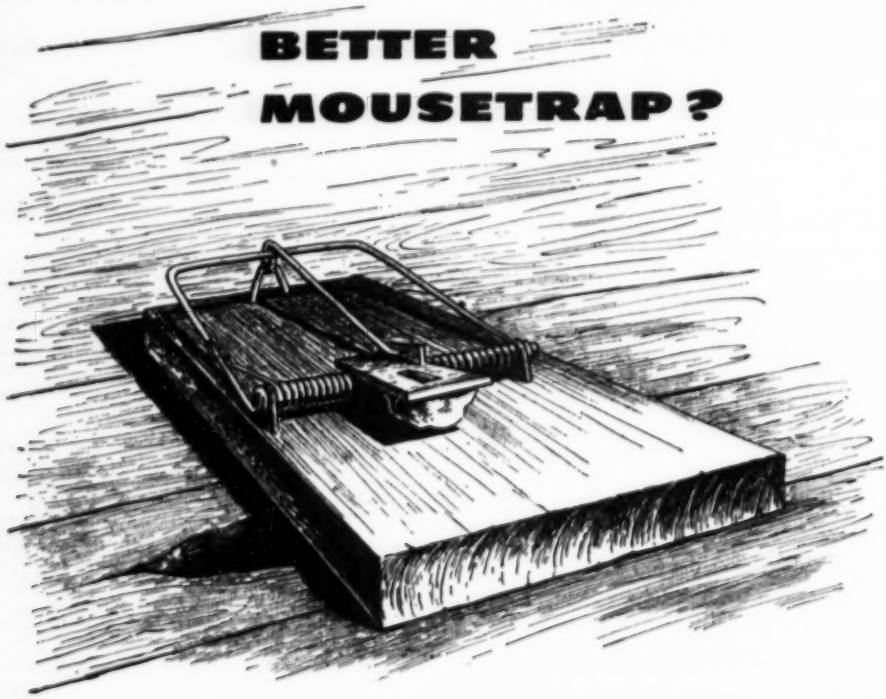


job rotation tour. Originally it was conceived as a five-year program—not to be confused with anyone else's Five-Year Plan. Experience with the program and evaluation of its results has indicated a shorter period can accomplish as much good.

The explanation, according to Mr. Waring is: "In three years we believe a good man has been exposed to enough different environments, situations and experiences and enough different people for us to form as good as possible an opinion of his over-all capabilities and future potential."

Even the present three-year concept is not inflexible. One man might go the full term, with as many as four or five different assignments in that period. Another might have a much shorter tour. The maximum length of each job assignment is held down to one year.

Also, a participant may return to his original department, or end up in an altogether different function. No two men are expected to produce identical results, or follow the same set pattern. That is why the panel considers each



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case separately, judges each on its own merits and avoids rigid rules and criteria.

Nor is a formal rating system used, although department heads to whom a man is assigned on his tour do fill out a standard rating form; but it is only a general guide. What counts is the consensus of the panel and the department heads involved. Decisions are threshed out in round-table sessions.

Eligibility for management development program training is not limited by age, though most men so far have been in the 35 to 45 age group. At first emphasis was placed on assignment of older men, reflecting the company's immediate need to fill vacancies when many retirements were due.

The peak has passed, though, and gradually the emphasis is shifting to younger men. In its first 10 years the program built up a sufficiently large reserve of management-trained men to meet current needs. Now it is geared more for the long pull.

The program's roster is smaller now than at first when as many as 60 were assigned to it at one time, and the tours have been shortened. As a result, the progress of each participant can be more closely monitored. However, the program can be expanded, contracted, or otherwise adapted to meet a new situation at anytime.

This same flexibility also applies to the cadet program, a training program for younger men in their twenties likewise administered by members of the management development program panel.

The cadet program is for newly hired college graduates and for employees, generally under 30 years old, who have earned college degrees since joining the company or have gained its equivalent in specialized studies and practical on-the-job experience.

During a young man's assignment to the cadet program, a two- to three-year period of familiarization and training along functional lines, his progress is closely followed by the panel. However, cadet training is divided into two categories, representing engineering and non-engineering functions. Appropriate members of the panel are responsible for each of these groups.

Usually a cadet ends up in the department where he was initially placed, though in the interim he is given several different assignments. If one of these seems the best spot for him, he will probably stay there. It's a junior version of the management development program to get a young man started off on the right foot.

After his cadet training is over, he's on his own. Later on, if he makes out well, he may be selected for the management development program. This won't happen, however, until he has had time to progress in his specialty, mature, and develop his capabilities and value to the company and himself.

Maybe one of those young men knocking at Con Edison's door, still-fresh June sheepskin in hand—or more important with ambition, initiative, and eagerness to learn—is one of those born executives. Or maybe he is that ideal raw material out of which they are made. Time, experience, and trial by performance will tell.

This much is certain, though, if he falls into either of these categories, though he may not know it himself at the time, his potential will not go undetected or undeveloped.

Con Edison's constant search within its ranks for that "good bet" Mr. Waring is determined the company will not miss, will take care of the detecting. The management development program will turn that bet into a sure thing.

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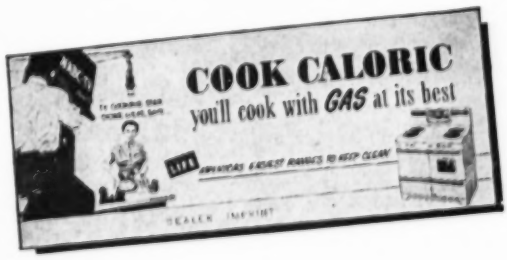

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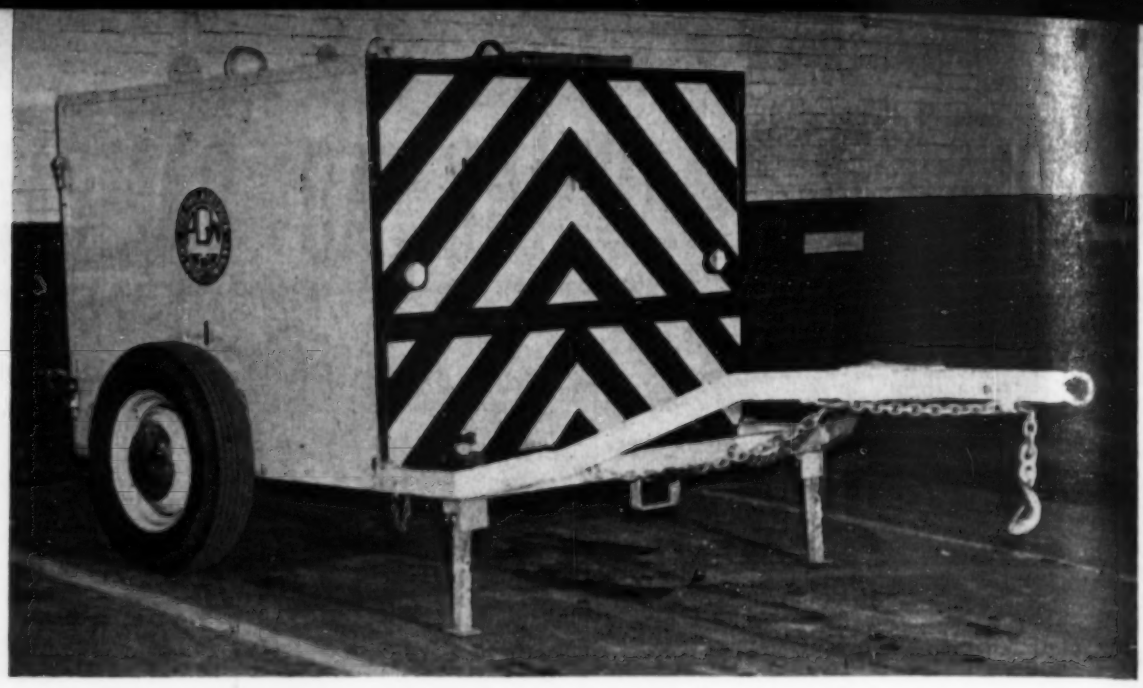


Emergency trailer stands by for quick shutoff of gas service

RIGHT inside the south entrance of Montgomery garage of Philadelphia Gas Works stands a well kept but seldom used piece of rolling stock. With the exception of a relatively few hours, it has been standing there for more than five years. And it is quite likely that many of the hundreds of people who see it every day don't know what it's for.

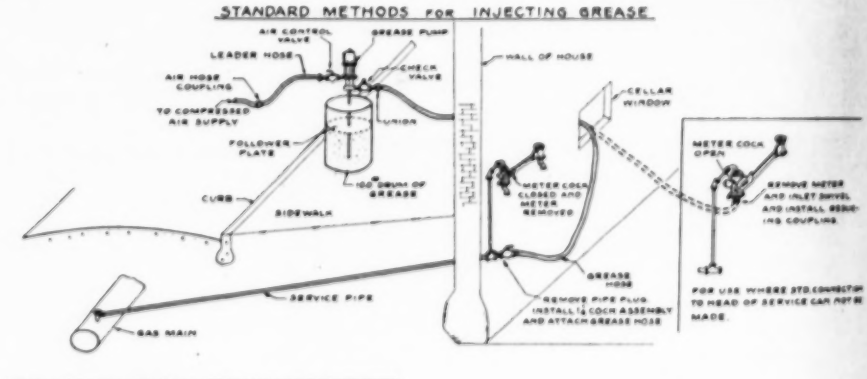
Properly called an emergency trailer, it is fitted with equipment used by the street division of the distribution department. As the name implies, it is for emergency street work. The most likely kind of emergency is the quick shutoff of gas flow in an underground main before making a street opening. Carried on the trailer are the tools and equipment used in stopping or preventing the escape of gas in much less time than it normally takes to break a street, dig a trench—generally through frost—possibly drill and tap a main and then bag off the main at several places.

Since one of the functions of this emergency unit is to shut off or prevent the flow of gas by the use of grease, the item of principal concern is the grease pump needed in this operation.

A Lincoln drum pump was chosen for three reasons. First, it has the capacity to handle the quantity of grease to suit our requirements. Second, it forces the grease at the needed pressure to meet our time requirements. Third, it will handle the viscous grade of grease required for this particular job. How it works is illustrated in the drawing on this page.

Other units needed in the operation of a drum pump, and the trailer carries two of them, include an air compressor hose to lead from the compressor and specially fitted to connect at the pump air motor ends; several lengths of grease hose through which the grease is transferred from the pump to the gas service; various adaptors for tees at the head of the service in the customer's premises, and various adaptors for meter connections when it is not convenient to use the head of a service; a short length of ¾-in. pipe for use in the bar-hole method of shutting off gas; various sizes of gas service stoppers; and wrenches for the grease drum covers. All of this equipment is carried in a box 4½ ft by 1½ ft by 1 ft and weighs 160 lb.

Five 100-lb drums of grease are carried in the trailer. Heavy grease is carried during the warm months while during the winter the drums carry a 50-50 mixture of heavy grease and cup grease. Each drum is equipped with a light weight follower plate which per-


STANDARD METHODS FOR INJECTING GREASE
AIR CONTROL VALVE
GREASE PUMP
LEADER HOSE
CHECK VALVE
AIR HOSE COUPLING
TO COMPRESSED AIR SUPPLY
UNION
FOLLOWER PLATE
100 LBS DRUM OF GREASE
CURB
SIDEWALK
SERVICE PIPE
GAS MAIN
WALL OF HOUSE
CELLAR WINDOW
METER COCK CLOSED AND METER REMOVED
GREASE HOSE
REMOVE PIPE PLUG INSTALL ¼ COCK ASSEMBLY AND ATTACH GREASE HOSE
METER COCK OPEN
REMOVE METER AND INLET SWIVEL AND INSTALL REDUCING COUPLING
FOR USE WHERE STD. CONNECTION TO HEAD OF SERVICE CAN NOT BE MADE.
ALTERNATE METHOD FOR INJECTING GREASE
GREASE HOSE
STREET PAVING
SIDEWALK
BARHOLE FILLED WITH GREASE
GREASE INSERTED THROUGH BAR HOLE WHERE HOUSE SERVICE IS NOT AVAILABLE
GREASE
GAS FLOW
EMERGENCY METHOD FOR STOPPING FLOW OF GAS IN SMALL LOW PRESSURE MAINS

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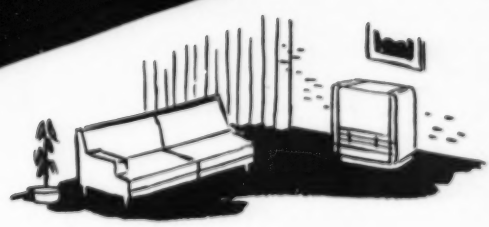

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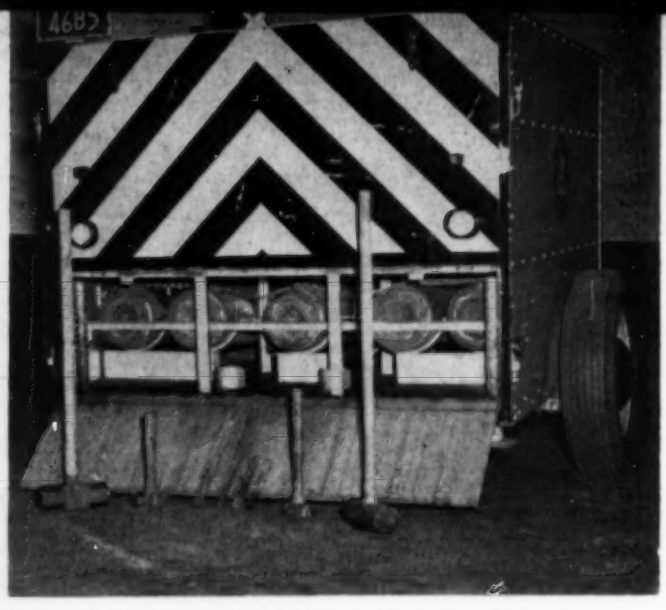

Rear view shows non-sparking tools and five CO_2 tanks connected to manifold. This emergency trailer carries everything needed to meet the situations faced in nearly every emergency where a shutoff must be made.

Workman dressed in asbestos suit and a Chemox breathing apparatus demonstrates some of the equipment carried on the emergency trailer. A grease pump is shown in a drum of grease at left.

forms the two-fold function of keeping the grease packed down as it is used from the drum, and of being a gauge to the operator indicating the quantity of grease used.

This grease pumping equipment is used only in emergency situations where time for the shutoff of gas flow is an essential factor. A typical emergency would be where the possible hazards of sparks or fire make its use desirable. It is designed for use on small low pressure mains.

During an emergency, a 100-lb drum of grease is placed as near as possible to the head of the service through which grease will be injected into the main. The grease pump tube is placed into the drum of grease through a collar in the follower plate. An air compressor hose is connected to the air compressor and the grease pump. The meter cock on the service is shut off, the meter removed, and a special connection, which includes a meter cock and which is adapted to one end of the grease hose, is connected at the head of the service. The shortest length of grease hose connects the pump and special connection. The cock in the special connection is opened and the pump turned on and grease starts to flow immediately. While the pump is in operation, it is held upright in the center of the grease drum to permit the free downward movement of the follower plate as grease leaves the drum.

To stop the gas flow in mains 6 in. or smaller, approximately one-third of a drum (33 lb) of grease are required. About one-third of a drum is required for each 30 ft of 1¼ in. or smaller service pipe.

Proportionate quantities are required for larger mains or for larger or longer services. Ordinarily, the length of the grease "slug" is confined to approximately 3 ft of main.

Readily available equipment includes two grease gun cases, four drums of grease, asbestos uniform cases, breathing apparatus cases, fire extinguishers and metallic hose.

Should a service not be available near the point for controlling the gas flow, a bar-hole is made through the earth to the main and a sharp stone bar is driven through the top of the main. In this hole a ¾-in. pipe is immediately inserted with the shortest length of grease hose attached. To reduce the escape of gas from the bar-hole, the grease pump is operated while inserting the ¾-in. pipe through the bar-hole and into the main. The ¾-in. pipe must be held down to prevent grease pressure from pushing it out of the bar-hole.

Following the use of this equipment, there must be a cut-out to remove the section of main containing the grease and the service must also be renewed.

After the equipment has been used, it is inspected and cleaned, particularly the grease hose through which the grease was transferred from the pump into the service.

While the trailer's two grease guns get top billing, other equipment needed to carry out the emergency assignments on which it is used is equally important. For example, there are four drums of grease; two Chemox breathing apparatus (gas mask) outfits and two asbestos suits; one 50-lb CO_2 fire extinguisher, equipped with hose and funnel; five 50-lb CO_2 tanks connected to a manifold; one 30-ft length of metallic hose and funnel; one pair of asbestos gloves; and a complement of non-sparking tools.

Since the emergency trailer provides the tools with which Philadelphia's street division men face conditions calling for quick action, the men assigned to this work must be thoroughly trained in the application and use of each piece of equipment. More than that, they know also that every safety precaution has been taken to see that known hazards have been removed before each job is undertaken. The men know they have the best and safest equipment needed to accomplish a tough job under trying conditions.

This article has been adapted from a story appearing in the December 1953 issue of the *Philadelphia Gas Works News*.

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New 1954 Ranges Designed to Help Solve Your Retail Selling Problems!

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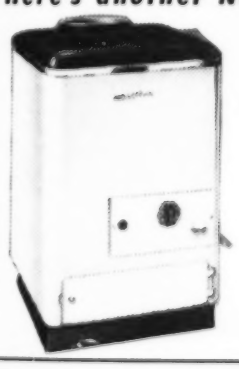

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YOU CAN'T SELL GAS THAT LEAKED OUT

New developments from househeating research

Adaptability of floor panel heat proved

PANEL heating attained full growth before its progenitors could adapt efficient methods for its upbringing. Research did not keep pace with panel system installations.

However, we have experimented in the floor slab laboratory at the University of Illinois, and our report consists mainly of findings on heat exchanges between the panel and its surroundings, and the effectiveness of several methods of insulation.

Four test rooms were used, three exposed only on the north, and one with both north and east exposure. Rooms A and B each had a window with an area equal to 10% of the floor area, while rooms C and D had two such windows each. Walls were thoroughly insulated, eliminating heat transfer between adjoining rooms. Floors were separated by 6 in. of cellular glass insulation, extending 4 ft into the ground from floor surface.

Soil under and adjacent to the laboratory contained 3 ft of fill, sloped for proper drainage. To establish heat loss into the ground, thermocouples were buried 20 ft under one test room. Thermostats were set to maintain a constant air temperature of 72° F at the 30-in. level. Heat meters and watt-hour meters were installed to check difference between energy input from the heater and heat output of the panel.

Careful checking of the test records showed air temperatures at the center of the rooms were very uniform with variations between floor and 60-in. level of only 0.5°. Fuel savings resulting from the use of insulation under the entire floor slab as compared to the use of edge insulation only were proven too small to warrant the difference in cost. Vertical insulation was as effective along the inside edge of the foundation wall as was L-type insulation. Material savings and ease of installation made vertical insulation preferable.

Comparisons of reverse loss from heated slabs indicated that the fuel consumption when using floor panels would exceed the amount necessary for radiator or convector heating by approximately 10%. Floor panel heating, however, had the desirable characteristic of automatically increasing the heat output rate in areas adjacent to points of high heat loss from the room. Chief result of the experiments was the addition of data to present knowledge of heated panel performance in basementless homes.

—E. L. Sartin and W. S. Harris, University of Illinois

Research on floor panel controls

THE American Society of Heating and Ventilating Engineers, in cooperation with the University of Minnesota, Minneapolis, recently concluded four years of field studies on floor panel control systems. This was an integral part of ASHVE research on possibilities of panel heating for home and industry. Covered are the results of field tests on various control systems in three different types of construction.

Type A installation (a heavy floor panel, heavy building construction, large glass area) was a single-story general office in a factory building. Type B (a heavy floor panel, light building construction, large glass area) was part of a factory section. Type C (a heavy floor panel, light building construction, small glass area) was in a residence. Studies were made in these installations for governing load conditions in which the principal factors were outdoor dry bulb temperature, solar radiation, wind, building construction (glass area, infiltration, thermal transmission, and heat storage capacity), and occupancy.

Constant heating load changes are of far greater consequence in a floor panel heating system than in any other type.

The articles on these pages are digests of papers presented at the 60th annual meeting of the American Society of Heating & Ventilating Engineers held in Houston on Jan. 25-27. Copies of the complete talks are available from the ASHVE, 62 Worth St., New York 13.

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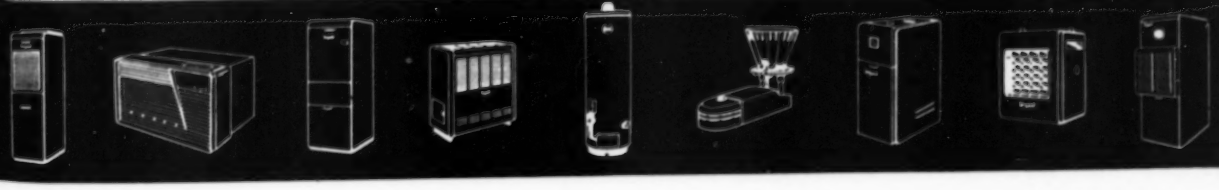

The large thermal inertia of the floor panel slab precludes a rapid change in the energy level of the slab. Outside weather conditions which effect a rapid change in heating loads are the intensity of solar radiation, outside temperture, wind velocity or direction.

Tests with solar compensators proved that they permit adjustment of boiler water temperature in accordance with sensed outside temperature. The solar compensator, an insulated enclosure with glass in one side mounted in the same plane as the glass in the building, takes into account immediate solar gain through wall glass area. It is oriented in the same direction as the heating zone it serves.

An outdoor sensing bulb, located on the west side of the boiler room, was unable to sense early solar effects. Therefore, energy was applied to the panel longer than was necessary. Locating this sensing bulb where it quickly detected solar effect lent immediate improvement to control of the panel system. A general control problem resulted from connecting the water returns of the separate zones to a common header. A temperature drop occurred when return water circulated.

A constant heating load depended almost entirely on the sensitivity of the thermostat. Exposed walls, air temperature distribution, air motion, and floor coverings were checked thoroughly for effect on controls. An on-off type of valve provided greater variation of panel water temperature with less frequent operation. Magnitude of variation depended on method of boiler water temperature control. A mixing valve's damping effect eliminated the necessity for proportioning of boiler water temperature.

A space thermostat used in conjunction with reset boiler water temperature sensed the change in internal or space temperatures which would normally occur from conditions other than the change in outdoor temperature. If boiler water temperature was reset with outdoor temperature, the thermostat functioned as an auxiliary or secondary control element of the overall control system. When boiler water temperature was constant, the thermostat functioned as a primary control element of the overall control system.

We believe that all practical data possible from field tests have been obtained, and suggest further work of a laboratory nature where a controlled environment can be maintained.

—A. B. Algren and R. R. Head, University of Minnesota; and E. F. Snyder Jr., Minneapolis-Honeywell Regulator Co.

●

Furnishings no obstacle to panel heat efficiency

TO answer the question, "Will furniture and floor covers affect panel heating efficiency?" a special test room, 12 ft wide and 24½ ft long, with the ceiling adjustable to any height up to 12 ft, was used at the society's research laboratory. Known as the Environment Laboratory, it formerly was used to test panel heating in uniform conditions and without furnishings or floor coverings.

In the recent tests both ceiling and floor temperatures were used with various configurations of wall and floor, or wall and ceiling temperatures, plus varied infiltration rates to produce nonuniformity. Room air temperatures were taken at points 30 and 60 in. from the floor in the center of the room. Deviation between uniform and nonuniform conditions was within 5% with

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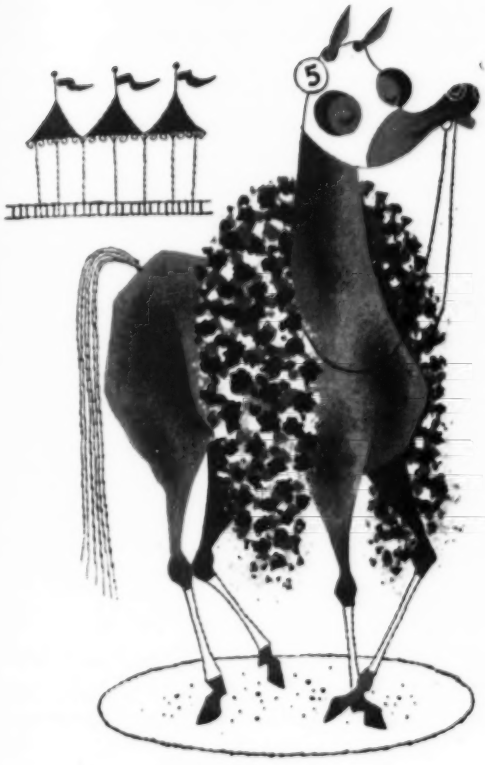

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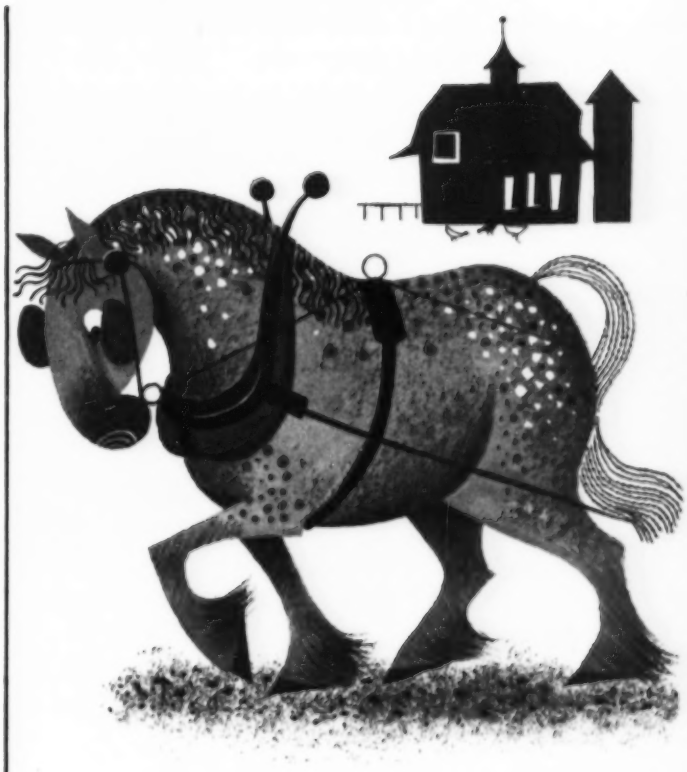

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ceiling panels. Floor panel tests showed a deviation in air temperatures of less than 1.5°.

A davenport, five office armchairs with leather seats and backs, a large table, two small tables, and three lamps, having a total projected area of 200 sq ft, were placed in the room. The introduction of this furniture caused a decrease in heat output from both floor and ceiling panels. This decrease was caused by furniture obstruction to direct radiation. The reduction in output was about 5% for both uniform and nonuniform conditions.

Although heat output decreased, the furniture heated enough to convect heat to air and increase the room temperature. This temperature increase is greater with ceiling panels because convection already accounts for a large part of floor panel output.

Use of floor coverings of various materials, with and without pads, caused a much higher output from the heating medium. A 44° higher output was necessary with wall-to-wall wool carpeting over a hair and jutepad. A careful selection in floor coverings is necessary with panel heating. Three-ply all wool carpeting with a 3/16 rubber pad is best with panel heating because of the higher thermal conductance.

Conclusions reached were that furniture has no great bearing on the effectiveness of panel heating, either ceiling or floor. Floor coverings presented no problem that careful selection, use of separate coils or circuit for each room, and closer tube spacing, could not overcome.

—L. F. Schutrum and C. M. Humphreys, ASHVE Research Laboratory

•

Year 'round comfort from one system

EFFICIENT year 'round air conditioning of residences by distributing heated air in the winter and cooled air in the summer from the same supply outlets seems improbable, if not impossible, to the average home owner. However, we believe it can be done.

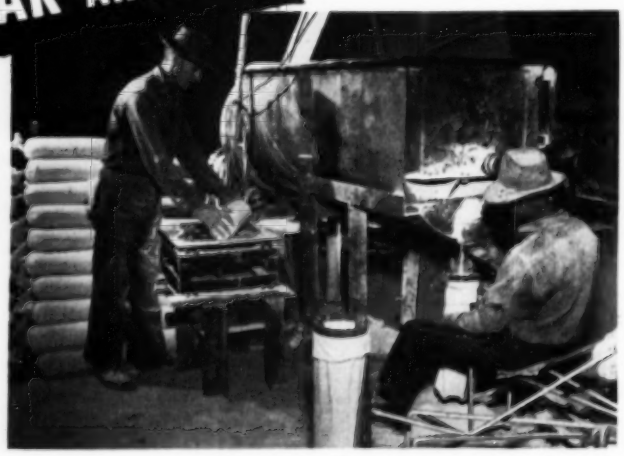
Research was accomplished by using a room 13¾ ft wide and 18 ft long with an 8½ ft ceiling height. This was surrounded by an insulated structure to form corridors along the north and east walls of the room. Facilities were available to independently control the temperature in the corridor, in a basement space below the room, and in an attic space above the room.

A range of —10° F to 130° F was used to simulate exposed walls of the room on the east and north sides, and inside walls of the room on the south and west sides. Approximately 70 thermocouples were used to obtain temperature range. Several sizes of floor registers and floor diffusers were installed singly at one of three locations in the test room. Wall outlets were tested at various heights.

The experiments indicated better air distribution from floor outlets than from ones located high on the side wall. Floor diffusers produced a more uniform air motion and a lower temperature variation during heating than did floor registers. Storm sash installed on the windows obtained only slight improvement in air distribution. Floor outlets at the center of the exposed wall promised excellent air distribution during year 'round air conditioning, especially if the flow rate during summer is maintained during winter heating.

—H. E. Straub and C. F. Gilman, University of Illinois

VIBRA-PAK ANODES



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Corrosion engineers tell their own story how VIBRA-PAK anodes successfully lessen corrosion on submerged or buried metal structures. Here is an authentic case history, from the files of a major company telling how VIBRA-PAK anodes effectively and economically reduced installation cost on a 60 mile section of pipeline.

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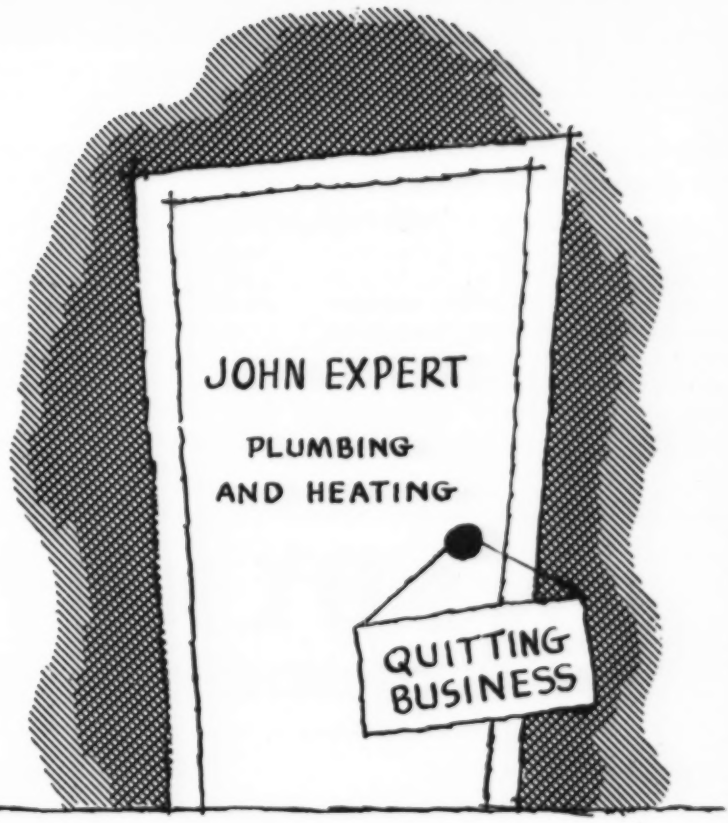

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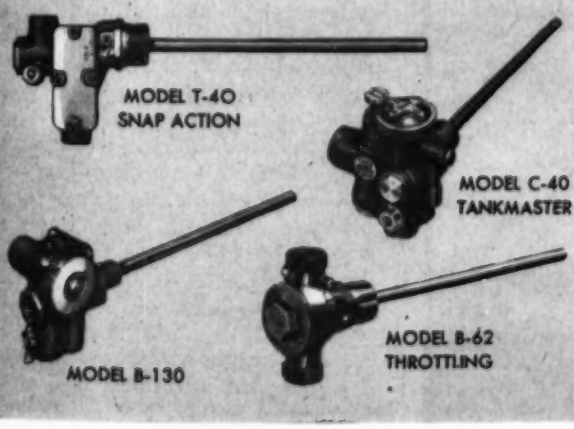

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NEWS

SGA urges alternate plan for discontinued trade show

At a recent meeting of the Southern Gas Association board of directors, a resolution was directed to the Gas Appliance Manufacturers Association suggesting that some alternate plan be considered for the promotion of the gas industry at the consumer level in lieu of the biennial Atlantic City trade show, which is being discontinued.

The resolution reads, in part: ". . . Omission of the trade show emphasizes the need and provides the opportunity for redoubled efforts elsewhere to promote most effectively the proper utilization of gas in the interests of gas appliance and equipment dealers and other segments of the gas industry.

"We endorse such decision on the premise that sums heretofore expended for the trade show can and should be more advantageously expended in the important job of combatting the massive promotional efforts of the gas industry's competitors."

The SGA urged GAMA, and its members to devise and sponsor an alternative program directed at the gas consumer level, calculated to promote more effectively than ever the fullest appreciation and use of gas, "such program to be in lieu of the trade show and supported by a budget at least as large as that devoted to the discontinued show."

New Jersey labor disputes to be studied by committee

A nine-man committee has been appointed by New Jersey's Governor Meyner to study and submit recommendations on legislation to afford "fair and equitable treatment to affected segments of society in public utility labor disputes.

Made up of three representatives each of public utilities, labor and the public, the committee will submit its recommendations within six weeks of the date of its appointment (Feb. 1) so action can be taken by the current session of the state legislature. Luke A. Kiernan, general claims counsel for Public Service Electric & Gas Co., is a member.

An existing New Jersey law, which provides for compulsory arbitration of labor disputes in public utilities where other settlement efforts fail and which provides for state seizure of struck utilities, has been opposed by the Democratic party and labor organizations.

Meanwhile, a bill to repeal the state's present public utility anti-strike law has been introduced in the legislature by Assemblyman Thomas Lazzio, who unsuccessfully sponsored a similar proposal last year.

Residence built for study of new heating methods

The nation's newest scientific laboratory is one that looks like a house and actually is a house dedicated to the search of new, better, and more efficient ways to heat and cool America's millions of small homes, both new and old.

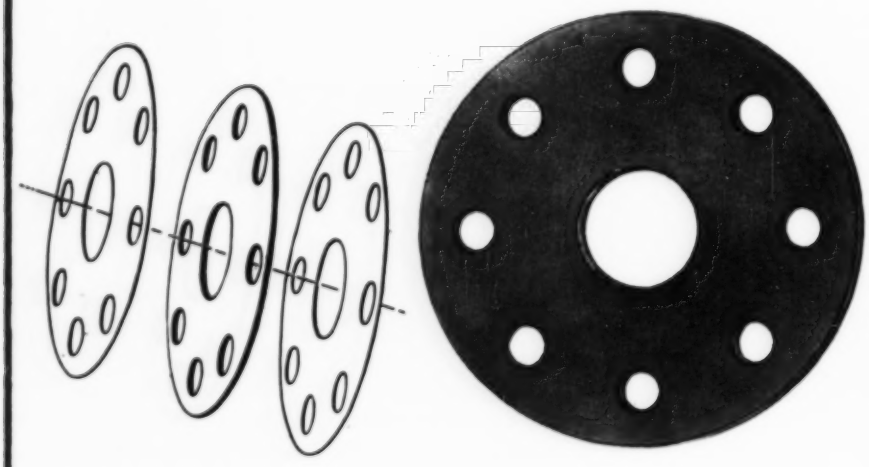
Designated the FIR Research residence, the new six-room structure is part of the test facilities at the Wichita University Foundation for Industrial Research.

The initial testing project, scheduled to begin last month, will be in the interest of the Coleman Co. to measure scientifically the effectiveness of heating equipment for houses built over a concrete slab. In the first experiments, air ducts only 3½ in. in diameter have been imbedded in the slab floor. The ducts connect a centrally located forced air furnace with new type registers installed in the floor and near the outside walls of each room in the house.

To find out what happens to the warm air from the time it leaves the furnace until it flows into the living space, FIR engineers have imbedded wire thermocouples to a depth of 4 ft below the surface of the slab. The thermocouples lead to automatic recording instruments, which peridically jot down the temperature at the end of the wire. More thermocouples are buried at depths of 3 ft, 2 ft, and 1 ft. In all, there are 375 temperature check points beneath the floor.

INSULKET*

THE "SANDWICH" GASKET



- INSULKET has a hard plastic core and sealing surfaces of a special ASBESTOS compound.
- The plastic core serves as an electrical insulator for use with cathodic protection work.
- The ASBESTOS surfaces are soft enough to seal easily, yet so tough they will not squeeze out under pressure.
- INSULKET is put together under high pressure and heat, and will not separate.
- Working pressures over 2000 p.s.i. W.O.G.
- Sizes up to 48½" OD.

*INSULKET—PATENT PENDING

SERVICE ENGINEERS, INC.

Manufacturers of Industrial Plastic Products

3030 W. Pafford P. O. Box 11068 Fort Worth 9, Texas

50 at floor level and 150 within the house.

In addition, 10 pitot tubes for measuring the speed of the warm air as it moves through the ducts are connected to the recording instruments.

In a special test section in the living room, a 4-in. duct of clay sewer tile has been buried beneath 4 in. of concrete. Beside it and also buried to a depth of 4 in. is a standard 3½-in. metal duct. Next in line is a 3½-in. duct buried to a depth of only 2 in.; fourth and last is a 3½-in. duct covered with glass fiber insulation, and buried under 4 in. of concrete. The results of the research will show which duct is best for heating slab-floor houses.

In order to fit a variety of heating and cooling systems to the house, its interior walls are easily removed or changed about. Space has also been provided in the attic for installation of a horizontal type furnace and cooling unit.

Ten gas companies honored by management institute

The American Institute of Management, New York, has honored 10 gas companies—two for the fourth consecutive year—as "excellently managed."

The four-time winners are Pacific Gas & Electric Co. and Pacific Lighting Corp., both of San Francisco. Third-time winners are American Gas & Electric Co., New York; Cincinnati (Ohio) Gas & Electric Co., and Washington (D. C.) Gas Light Co.

For the second time, El Paso (Texas) Natural Gas Co.; Iowa-Illinois Gas & Electric Co., Davenport, Iowa; Lone Star Gas Co., Dallas; and Oklahoma Natural Gas Co., Tulsa, were designated "excellently managed." The Pacific Gas & Coke Co., Portland, Ore., received the designation for the first time from the AIM.

Among manufacturing firms honored by the Institute was Dresser Industries Inc., Dallas, winning it for the fourth consecutive year.

Kansas questions purchase of Gas Service Co.

The proposed sale of the Gas Service Co., Kansas City, Mo., to Missouri Public Service Co. cleared a hurdle in Missouri but ran into one in Kansas. The Missouri PSC has approved the purchase of the Cities Service Co. subsidiary by Missouri Public for $32 million. However, the Kansas Corporation Commission ordered Cities Service not to sell any stock in Gas Service until the agency completes an investigation.

The Missouri PSC, in approving the sale, said it saw no evidence that the sale and eventual merger of the two companies would be harmful to the public or interfere with present supplies of natural gas to Missouri customers.

The Securities & Exchange Commission,

A Money-Saving Crane-Hoe TEAM

Quick Boom Switch Means Easy Matching of Front-end to the Job!

Here the Hydrohoe digs a trench. By telescoping boom operator can peel off scallops at grade level — dig a smooth, even trench.

A quick switch and here's the Hydrocrane — setting gas line pipe. Telescoping boom permits reaching out without moving crane an inch.

Owners report switching Hydrocrane and Hydrohoe booms in less than an hour. This exceptional convertibility can save time — mean additional savings for you. For example, you can dig trenches or valve pits in the morning — convert to crane front-end — and set pipe or handle supplies in the afternoon.

With this quick, simple convertibility, the all-hydraulic Hydrocrane offers you 30H53

- ★ 50 mph. travel speed on open road
- ★ Quick-set hydraulic outriggers
- ★ Simple, hand lever control — no foot brakes
- ★ Telescoping boom that gives you eight extra feet of reach
- ★ Safety and exact precision of hydraulic operation

See your distributor for a demonstration. We will be glad to send you his name.

BUCYRUS-ERIE COMPANY

South Milwaukee, Wisconsin

which has to approve the sale of stock, granted a one-week delay in its hearing to the Kansas commission, which originally asked for a three-day delay. All other intervenors withdrew objections.

Cold weather brings new laws, records, shortages

Designed to guarantee Kentucky residents enough gas to heat their homes during extremely cold weather, an order issued in January by the state public service committee provides that in periods of emergency brought on by low temperatures, gas companies must reduce the amount of gas delivered to industrial commercial users.

While the order leaves it up to the individual company to decide when an emergency exists, it provides that "when a shortage of gas affects the welfare of residential users," the company must first require industrial customers to use only enough gas to prevent damage to equipment. If cutting down on industrial customers is not enough, then gas delivery to commercial customers must be restricted. Hospitals and charitable institutions are, of course, exempt from the order.

The order also provides that if an industrial or commercial firm fails to comply with a gas company's order to restrict the use of gas, the company must immediately cut the user off from further gas service.

One of the areas hit hardest by a gas shortage during the late-January cold wave was the territory of the Gas Service Co. of Kansas City, Mo. There was no precedent for the gas shortage because it was the first time that such severe cold had come simultaneously to all areas the company serves. Conservation measures were instituted when pressure in the transmission line dropped to about one-third of capacity at one point with all compressor stations operating at full capacity.

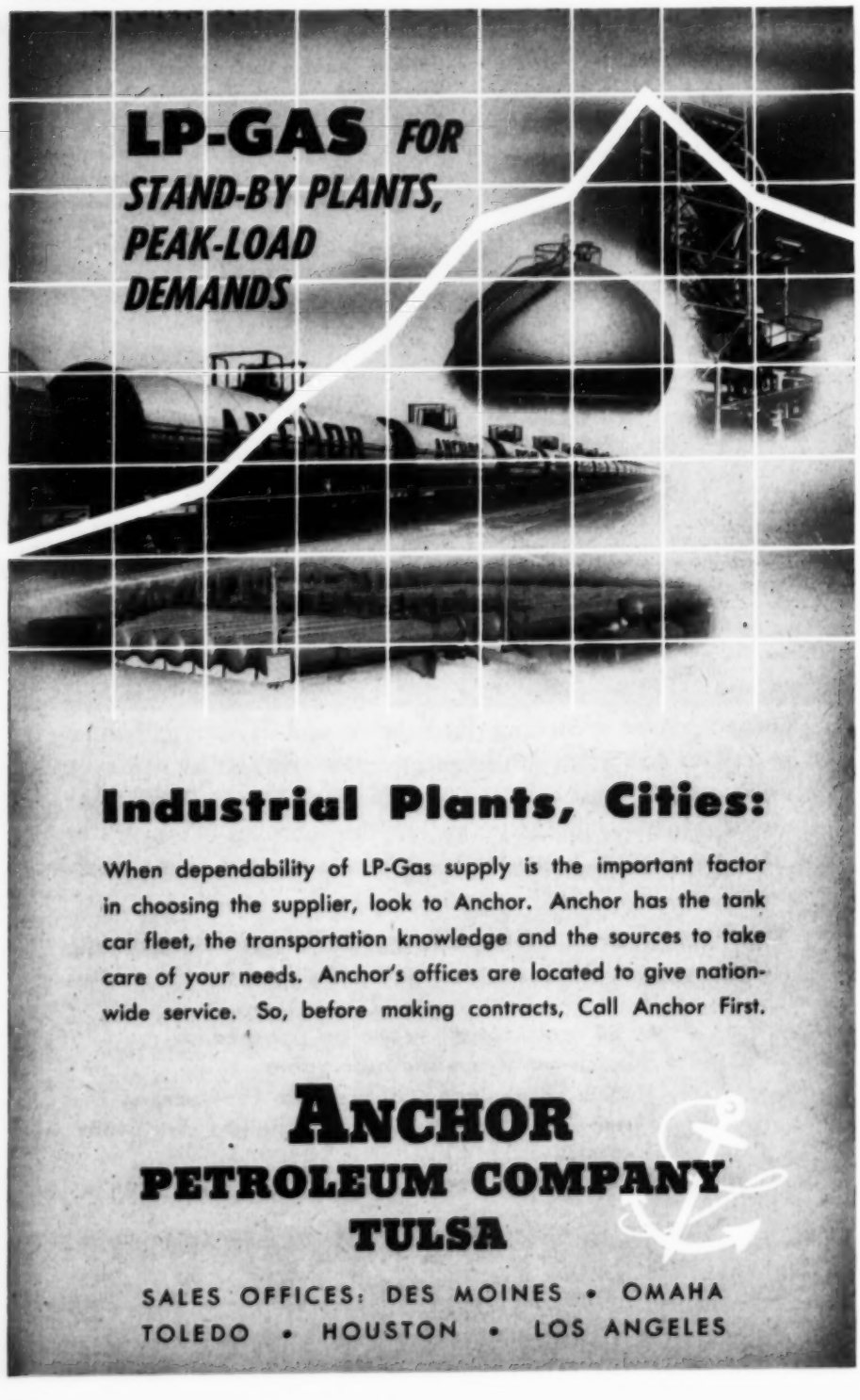
In New York, the January cold spell resulted in record sendouts of gas. For the week ending Jan. 17, ConEd had a sendout of more than 2.2 billion cu ft, which was an increase of 29.9% over the same week last year; Public Service Electric & Gas Co., in New Jersey, had three new record peaks—the highest on Jan. 17, when 466,745 Mcf went out; Brooklyn Union hit its peak on Jan. 13 when the total sendout reached 133,130 Mcf.

Public demand for gas is difficult problem

"One of the most difficult problems before the industry today is to meet the insistent public demand for more gas service," reported A. W. Conover, president of Equitable Gas Co., Pittsburgh, in a talk presented before a recent meeting of the Federation of Security Analysts Societies.

According to Mr. Conover, the gas industry is probably the only industry that still has a backlog of customers waiting for service. ". . . We don't have to wait in line today for any make of automobile as we did after the war. But many gas companies still have thousands of customers waiting for house-heating service."

At Equitable there are several thousands of customers on the waiting list, in spite of


LP-GAS FOR
STAND-BY PLANTS,
PEAK-LOAD
DEMANDS
Industrial Plants, Cities:
When dependability of LP-Gas supply is the important factor in choosing the supplier, look to Anchor. Anchor has the tank car fleet, the transportation knowledge and the sources to take care of your needs. Anchor's offices are located to give nation-wide service. So, before making contracts, Call Anchor First.
ANCHOR
PETROLEUM COMPANY
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SALES OFFICES: DES MOINES • OMAHA
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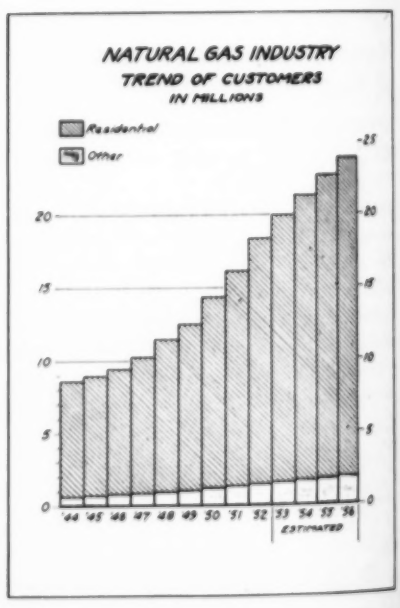


the fact that the company has added house-heating installations at the rate of about 10,000 jobs per year for the last several years. "The public wants more gas service and we, as gas utilities, must find ways to meet their demands."

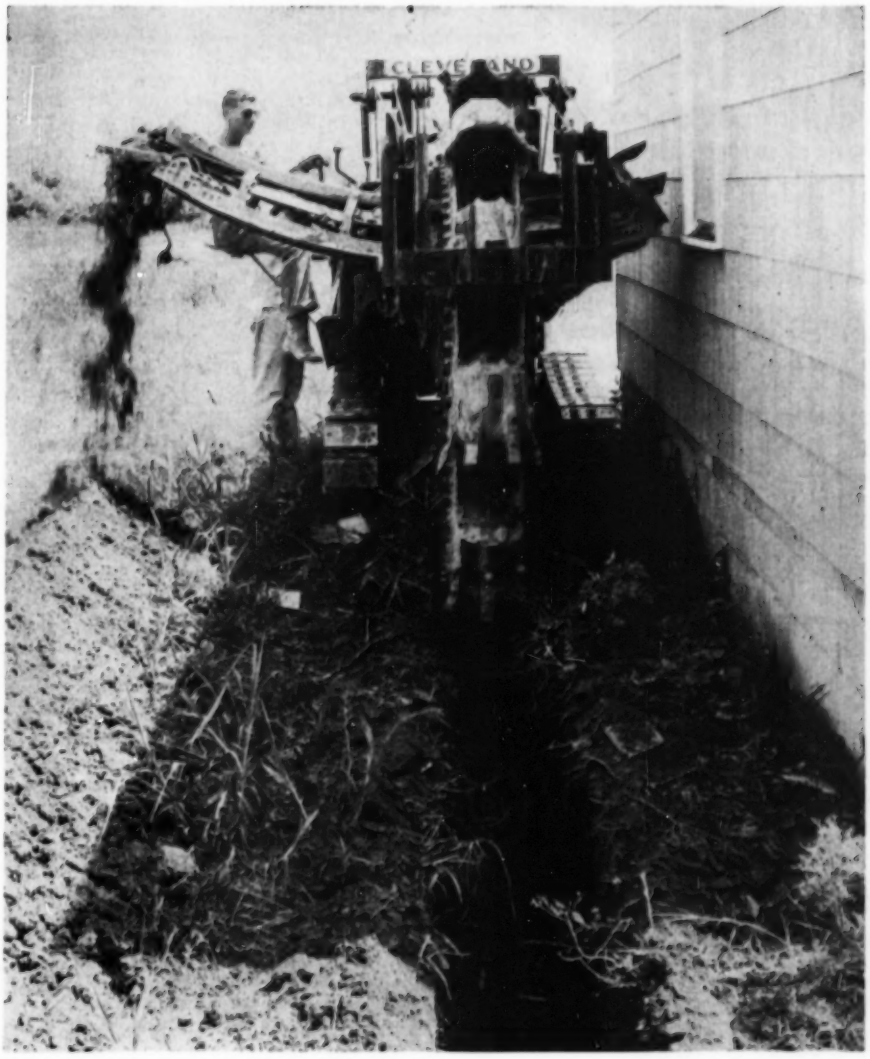
". . . Last year, the gas utilities added more than 1 million heating customers and the recent reports of the AGA indicate that about 1¼ million househeating customers will be added in each of the next three years . . ."

Hamilton Manufacturing Co., Two Rivers, Wis., is using the theme "Quit working on washday" in its most extensive magazine campaign in 15 years. Pictured is one of the full-page ads that will appear in 10 leading women's and shelter magazines, promoting the company's automatic dryers and washers.

Central Public Utility rids itself of last utility

By distributing to its shareholders its stock in Central Indiana Gas Co., Muncie, Central Public Utility Corp. has divested itself of its last domestic public utility subsidiary. Reorganization of the management of Central Indiana as an independent company is in progress. A proposal in that connection has been before the Securities & Exchange Commission.

Earlier in the SEC proceedings, Central Indiana had agreed it would not, without prior SEC approval, have any Central Public Utility officials among its officers and directors. In the pending application it seeks to continue on its board Christopher H. Coughlin, now president of both companies. He would give up the Central Indiana presidency but remain on the board. According to the application, Central Indiana intends to make its present executive vice president,



20" from Trench to Wall

IN NORFOLK, VA. this Model 92 CLEVELAND "Baby Digger" shows how its useful compactness enables it to place a trench safely within 20" of a house wall. Balanced perfectly on its smooth full crawlers, the 92 maneuvers easily in even the closest quarters, with less damage to lawns, walks and driveways. Because it digs any size of trench from 10 to 20 inches wide and up to 5 feet deep, it is usable on a wide variety of jobs.

The 92 hustles safely from job to job . . . at legal limit speeds . . . because it's so easily portable on the drop-axle, tilt-bed CLEVELAND T5 Trailer.

Write for descriptive literature and specifications or get the full story on CLEVELANDS from your local distributor.

THE CLEVELAND TRENCHER CO.
"Pioneer of the Modern Trencher"
20100 ST. CLAIR AVENUE • CLEVELAND 17, OHIO

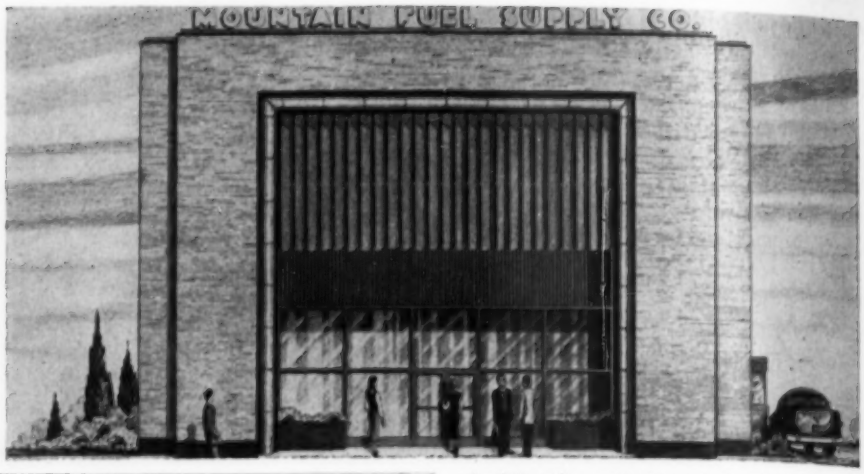
C. M. Cullison, its president and to continue him as a director.

Mountain Fuel expands Ogden operations

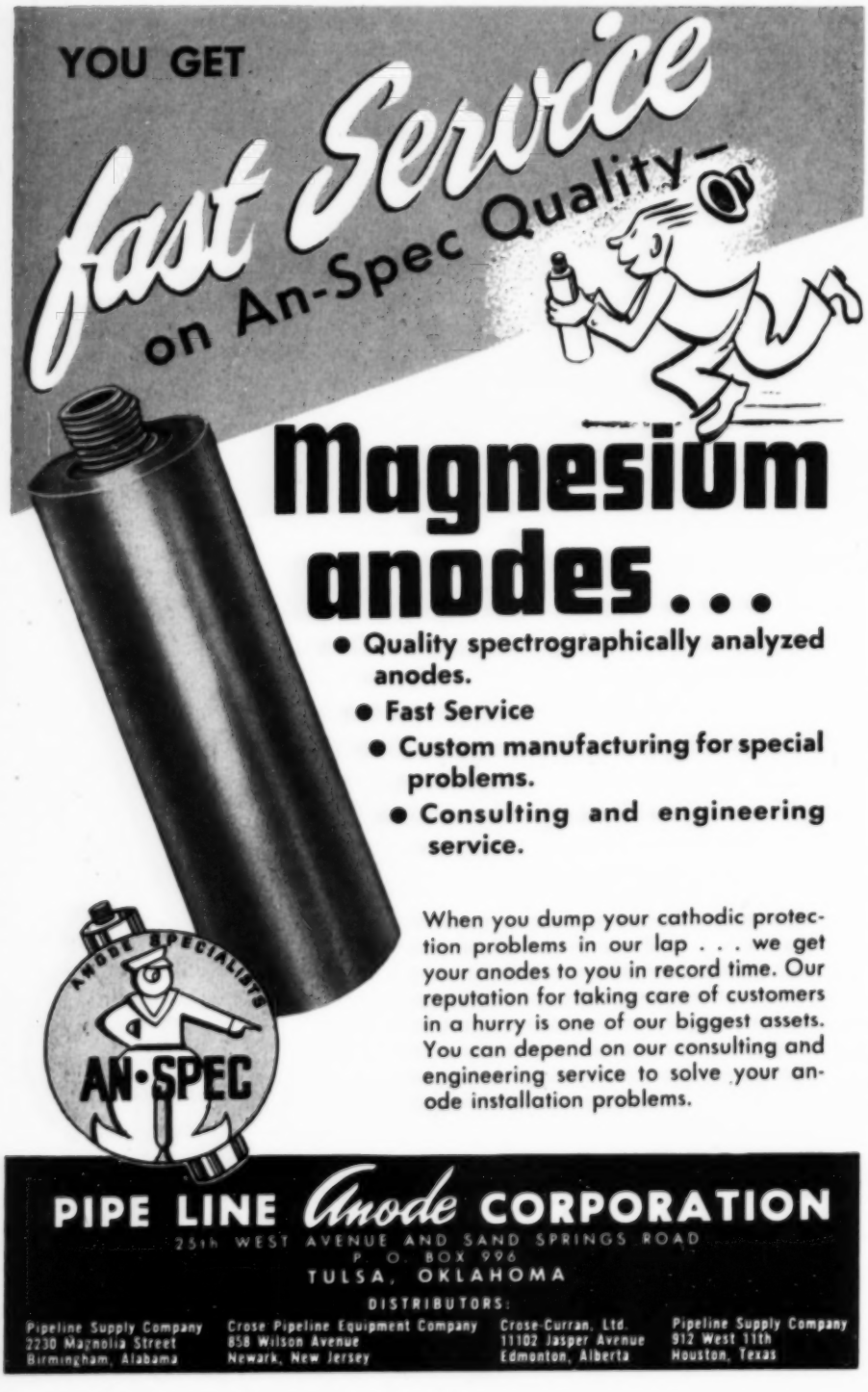
Rapid growth in the area has brought about the construction of new office and warehouse buildings at Ogden, Utah, by Mountain Fuel Supply Co.

The structures, to be built at a cost of $327,000, will consist of a main building that will house commercial offices, new business, distribution, service, and engineering departments. Provision is also being made for a drive-in window. Second floor of the main building will accommodate an auditorium, capable of seating 120 persons, and stage and demonstration kitchen. Warehouse and garage buildings will be located at the rear of the office structure. The buildings will cover some 25,000 sq ft in all.

Construction is already under way with completion scheduled for December.



Architect's rendering of the front elevation of Mountain Fuel's new office building in Ogden, Utah.


YOU GET
fast Service
on An-Spec Quality
Magnesium anodes...
● Quality spectrographically analyzed anodes.
● Fast Service
● Custom manufacturing for special problems.
● Consulting and engineering service.
When you dump your cathodic protection problems in our lap . . . we get your anodes to you in record time. Our reputation for taking care of customers in a hurry is one of our biggest assets. You can depend on our consulting and engineering service to solve your anode installation problems.
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AN·SPEC
PIPE LINE Anode CORPORATION
25th WEST AVENUE AND SAND SPRINGS ROAD
P. O. BOX 996
TULSA, OKLAHOMA
DISTRIBUTORS:
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Birmingham, Alabama
Crose Pipeline Equipment Company
858 Wilson Avenue
Newark, New Jersey
Crose-Curran, Ltd.
11102 Jasper Avenue
Edmonton, Alberta
Pipeline Supply Company
912 West 11th
Houston, Texas

California court rules for SoCounties in county suit

The California Supreme Court has decided in favor of Southern Counties Gas Co., Los Angeles, in the suit brought by the County of Los Angeles relative to franchise payments for the use of public streets.

By a six to one verdict, the court ruled that the 2% franchise payment to the county applies only to that portion of gross receipts arising from company facilities located on public highways—not from all company properties.

The case had been in litigation since February 1941, when the county first brought suit against SoCounties. The decision applies to all public utility companies in California having Broughton Act franchises.

Heater manufacturers aim at remodeled home market

"More money will be spent this year on rejuvenating old homes than on new housing starts," T. D. Bromley, chairman of the heating equipment division of GAMA, declared at a meeting held during the midwinter home furnishings market in Chicago. "This will mean a greater need than ever for individual space heaters to heat added wings, expanded attics, nurseries, playrooms,

and workshops, and to supplement existing central heating systems."

Thus, 21 million homes past the age of 30 have been voted the prime target of the gas heating equipment industry in 1954. Manufacturers of gas heating equipment, many of whom were engaged in defense production, are girding for their "biggest year" of civilian production.

Gas-operated TV set developed by Lee DeForest

A gas-operated TV set for demonstration purposes is being worked on by Dr. Lee de Forest, inventor of the vacuum tube.

The world-renowned physicist is making a modern adaptation of a thermopile principle discovered by a German scientist more than a century ago and is using gas as a means of producing enough electricity to run the set by heating unlike metals, copper and constantan, the same principle now used in home heating systems for turning burners on and off automatically.

The gas-operated TV set will be turned over to the schools and sent on tour as a demonstration of the thermopile principle.

GAMA announces winners commercial cooking contest

Minneapolis (Minn.) Gas Co., Piedmont Natural Gas Co., Charlotte, N. C., and Central Florida Gas Co., Winter Haven, Fla., were top winners in three classifications in GAMA's PEP contests, which was designed to boost the sale of commercial gas appliances. (See October 1953 GAS, page 82.)

Of 32 companies that entered, 24 completed the contest and submitted final sales figures.

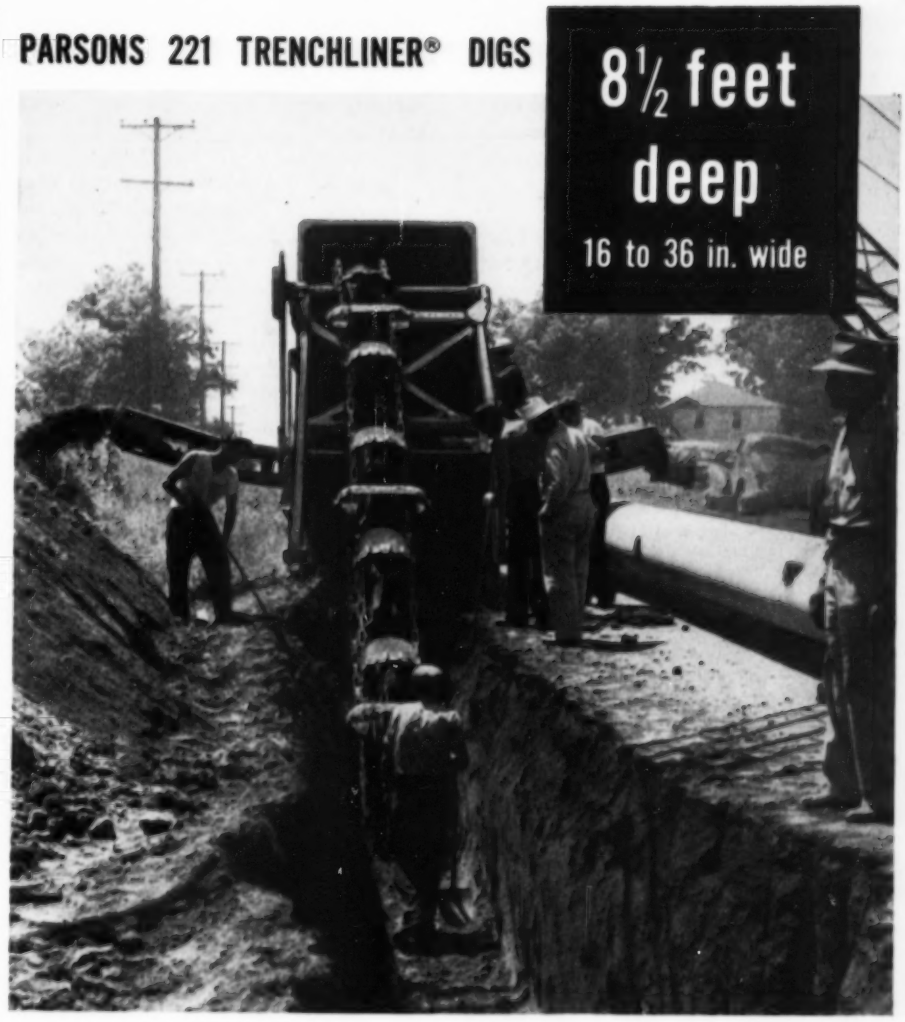
Honorable mentions went to the following companies: Group I, Peoples Gas Light & Coke Co., Chicago, and Oklahoma Natural Gas Co., Tulsa. Group II, Bridgeport (Conn.) Gas Light Co. and Binghamton Gas Works, Pittsburgh. Group III, Chattanooga (Tenn.) Gas Co. and Keystone Gas Co., Pittsburgh.

News Notes

The biennial Rice Exposition of Engineering, Science, and Arts is scheduled for April 2-3 at Rice Institute, Houston. The show, which is expected to be the most complete this year, displays the work of the various departments of Rice, with emphasis on engineering and science.

Plans for an annual award of $500 and a silver plaque to be presented to the outstanding appliance salesman in the country were announced recently by Lester D. Olin, director of appliance merchandising for the *Ladies' Home Journal*, at a meeting of the National Appliance & Radio-TV Dealers Association. Any salesman selling appliances

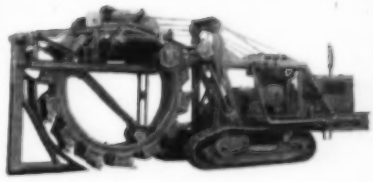
PARSONS 221 TRENCHLINER® DIGS



Parsons 221 Trenchliner combines big work capacity with extreme flexibility . . . digs from 6½ in. to 13-¾ ft. of trench per minute . . . 16 to 36 in. wide, up to 8½ ft. deep. Power-shift spoil conveyor dodges poles and other side obstructions without swerving from grade line . . . shifts completely through machine in less than 1 minute. Belt direction is instantly reversible to dump right or left.

Shiftable boom cuts within 10 in. of curbs and buildings. With full reverse of all operations, sloping ladder boom also undercuts sidewalks, sewers, old mains . . . makes vertical set-ins flush with foundations.

To learn more about what this heavy-duty 221 Trenchliner can do for you, contact your Parsons distributor, or write us. This same type machine is also available in 2 larger sizes, with cutting widths up to 6 feet, and depths to 17 feet, for your biggest jobs.



Parsons wheel-type Trenchliners dig 13 to 31 inches wide, up to 6 feet deep . . . are available in 2 models: 202 (shown) for drainage and utility trenches, Model 215 for cross-country pipelines.

Parsons rubber-tired Trenchmobile® drives job-to-job over highways or through city traffic at 12.6 m.p.h. road speeds . . . digs service connections, main line extensions 8 to 16 in. wide, in depths to 5 feet.

Send to: PARSONS COMPANY, Newton, Iowa *(Koehring Subsidiary)*

for literature on: ☐ 221 ladder-type Trenchliner ☐ 202 wheel-type Trenchliner ☐ 88 rubber-tired Trenchmobile®

NAME ..... TITLE .....

COMPANY ..... DIV. .....

STREET .....

CITY ..... STATE .....

P488 GAS

full time will be eligible and there are no restrictions on the kind of retail outlet. Points to be considered include volume, product knowledge, sales technique, follow-up, list price and fair trade-in, and company loyalty. A GAMA representative will be among the judges.

Iroquois Gas Corp., Buffalo, N. Y., has received PSC authorization to serve 15,000 more space heating customers, which should wipe out the company's waiting list for that service.

Joseph T. Ryerson & Son Inc., Chicago, is now distributing plastic pipe and fittings produced by Carlon Products Corp., Cleveland. Service on Carlon products is available through the 16 Ryerson steel service plants located across the country. The Carlon line supplements Ryerson's laminated industrial plastic supplied in sheets, tubes, and rods.

Servel Inc. has appointed the Boyd Engineering Co. Inc., Albuquerque, N. M., and El Paso, as distributors for its air conditioning equipment in New Mexico and the trans-Pecos section of west Texas.

It is estimated that more than 4000 homes and commercial buildings in Saskatoon are now being heated with natural gas served by a 107-mile pipeline from Brock, Sask., near the Alberta border, and running to Saskatoon. Six hundred additional contracts per month are expected to be issued this year for househeating.

For the month of January, natural gas company common stock prices were at the same level as a year ago. The price of common stocks for the composite index of 30 companies on Jan. 29, 1954, was $29.17, compared with $29.19 a year ago. Dividend payments for these stocks, however, increased from $1.41 per share to $1.48, a 5.0% gain. The price of the 10 gas transmission common stocks declined slightly over the comparable periods, while the price for the 10 gas distribution stocks increased.

Since it became available in January 1954, the Institute of Gas Technology home study course, "Natural Gas Production and Transmission," has been purchased by more than 700 enrollees and by companies for purposes of instruction. Company participation in the plan accounts for more than two-thirds of the first year's enrollments and sales.

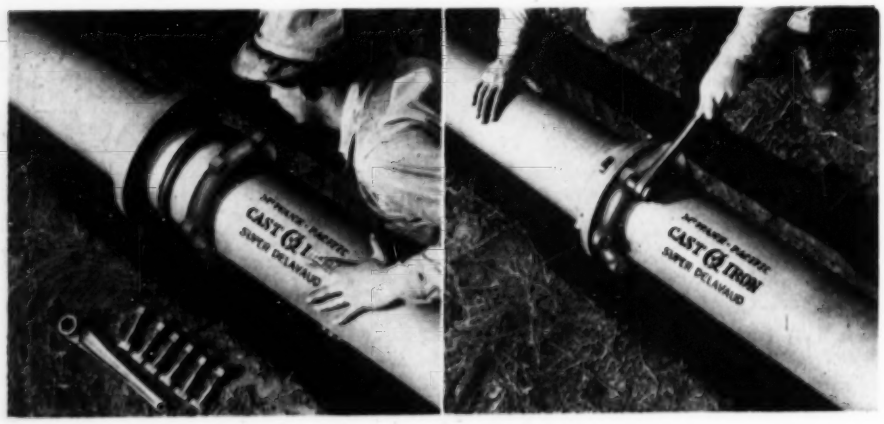
A nationwide "Burkay Jackpot" contest, with cash prizes for selling accomplishments, is being conducted by the Permaglass division of the A. O. Smith Corp. to stimulate commercial water heater sales in connection with the February-April promotion by the AGA. In addition to cash prizes for each unit sale of the Smith-Burkay line of commercial models, there will be bonuses to distributor or utility salesmen in each A. O. Smith district topping the individual bonus totals.

Merger of the Bangor and Pen Argyl gas companies has been authorized by the Pennsylvania Public Utility Commission. The merger will permit distribution of natural gas to about 2000 consumers in the Bangor-Roseto-Pen Argyl areas of Northampton county.

Commercial Distributors, with headquarters in Portland, Maine, have been appointed Servel appliance distributors for the state of Maine and northern New Hampshire. The company also has a branch at Bangor, Maine.

More than 55% of the employees of Peoples Natural Gas Co., Pittsburgh, had 10 or more years service at the end of 1953. Eighteen employees have 40 years or more service and 303 have between 30 and 40 years. Percentagewise, 1% of the employees have 40 or more years; 16.8% have between 30 and 40 years; 15.1% are 20- to 30-year veterans; 14.2% have 10 to 20 years; and 13.1% have between 5 and 10 years.

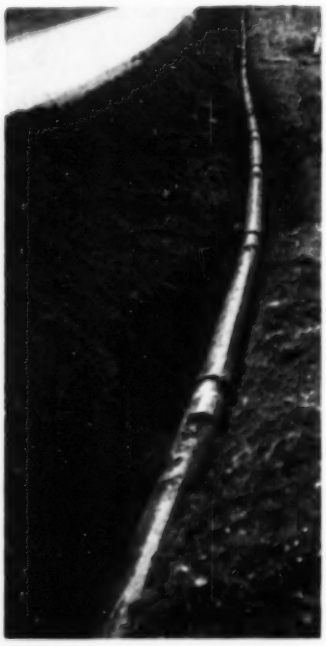
The Robertshaw-Fulton Controls Co. is one of the latest companies to announce its participation in the 1954 "Mrs. America" contest. Participation gives the controls manufacturer exclusive rights in its field to use the Mrs. America name, picture, and endorsement for advertising, sales promotion, and publicity.



EASY TO LAY

WITH UNTRAINED LABOR

SAVES TIME REDUCES COSTS



McWane-Pacific Boltite mechanical joint pipe and fittings lay faster and reduce pipe line construction costs because the joints can be made by untrained workmen using only a ratchet wrench. Boltite is a better joint for either water or gas. Bottle-tight, leak-proof, yet flexible to allow settlement, or expansion and contraction of the pipe line.

All joint parts, glands, gaskets and bolts are interchangeable with pipe, fittings, valves and hydrants made by other manufacturers. For complete information, wire or write McWANE CAST IRON PIPE COMPANY, Birmingham, Alabama, or PACIFIC STATES CAST IRON PIPE COMPANY, Provo, Utah. (Sales offices in principal cities.)

McWANE PACIFIC PIPE *Lasts for Centuries*

Abstracts

A REVIEW OF LITERATURE ON THE RESULTS OBTAINED BY MIXING VARYING AMOUNTS OF OIL WITH INDUSTRIAL GASES BEFORE COMBUSTION AT ELEVATED TEMPERATURES —by C. J. Slunder, C. J. Lyons, W. Gumz, and A. M. Hall, Battelle Memorial Institute. (An AGA report on project IA-6.) This project was concerned with a correlation of available information on the effectiveness of a combination fuel of oil and gas in such operations as forging furnaces. In such an application, the greater part of heat transfer is by radiation even with non-luminous flames. Past experience with forging furnaces has indicated the possibility of increasing the rates of radiant heat transfer by using a mixture of oil and gas as fuel because of the luminosity imparted to the flame by the oil.

This report touches upon a comparison of combustion characteristics of straight oil and gas fuels, including combustion processes, rate of combustion, composition of combustion atmospheres, flame temperature, and flame luminosity. Also considered is the effect of combustion processes on heating rates from the standpoint of radiation from flames and the relative influence of emissivity and flame temperature. The effect of hot gaseous atmospheres on scaling of steel with respect to quantity, structure, and adherence of scale is also included. However, no experimental data was found on the relative rates of heating by gas or by oil, or by mixtures of these two fuels.

FLUID GASIFICATION OF OIL — IGT Research Bulletin No. 16.

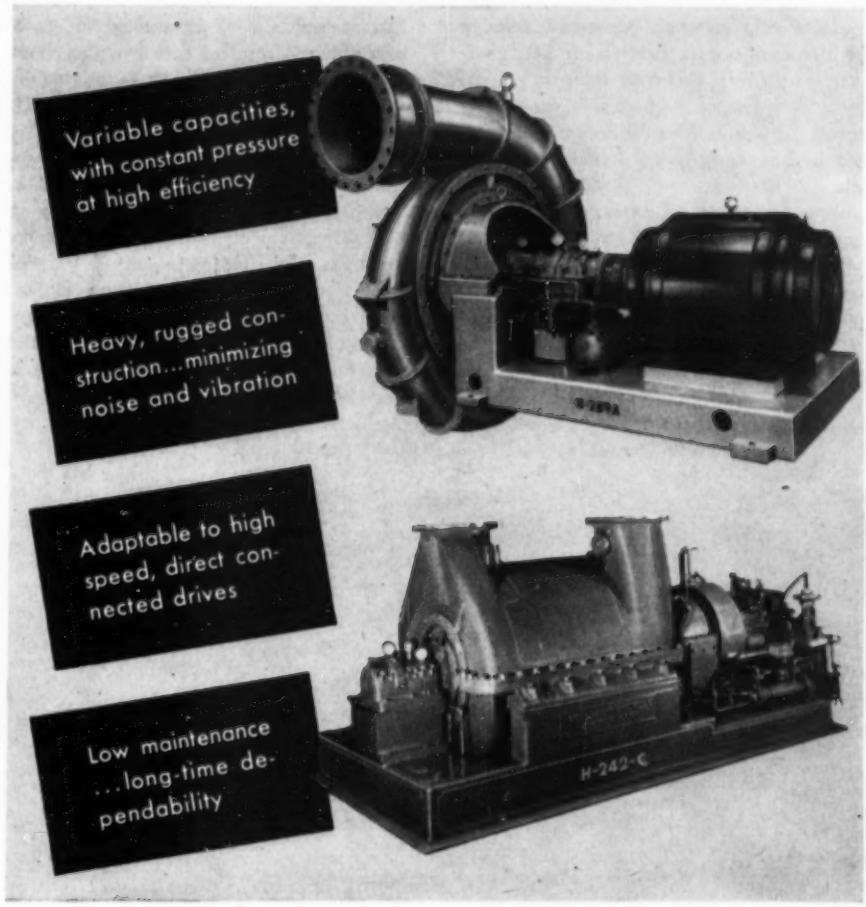
This bulletin presents the experimental data and observations from a study of the application of fluid cracking techniques to high-Btu oil gas manufacture. The process problems considered were the selection of solids for heat-transfer media, the design of suitable fluid gasification equipment, and the operating conditions for cracking liquid petroleum oils into high-Btu oil gases.

Fluidization studies were carried out in small-scale laboratory units. A number of

Correction

In the February issue of GAS in the article "An Operating Man Looks at Plastic Tubing for Gas Mains," by C. H. Webber, two errors occurred. In pointing out the requisites of plastic tubing, it should have read "Some materials will expand or contract some 6 in. per 100 ft with a ground temperature *change* of 30° F." Inadvertently the word change was omitted.

The Rule of Thumb box on page 45 should read 2-- 4-, and 6-in. plastic tubing will cost approximately 19%, 35%, and 29%, respectively, *more* than steel.


Variable capacities, with constant pressure at high efficiency
Heavy, rugged construction...minimizing noise and vibration
Adaptable to high speed, direct connected drives
Low maintenance ...long-time dependability
H-242-C

LOOK FOR THE "BIG 4"

WHEN YOU BUY CENTRIFUGALS

Your specific needs may dictate other important characteristics in centrifugal blowers or exhausters. But even so, these four values are essential to over-all successful performance. You'll find them in every Roots-Connersville Centrifugal Unit, regardless of size. And if you desire variations to suit your application, the ability to meet these needs is a heritage of our 100 years' specializing in equipment to handle gas and air.

You'll find first-cost economies, too, in the wide range of capacities of R-C Centrifugals. From 2,000 cfm to 100,000 cfm, you can choose the single-stage or multi-stage unit most closely matched to your individual requirements. You can count on the same high quality of performance that has made many thousands of first-time buyers enthusiastic, repeat customers for R-C equipment.

For your present or future requirements, we suggest you call on Roots-Connersville, for 100 years the specialists in handling gas and air.

ROOTS-CONNERSVILLE BLOWER

A DIVISION OF DRESSER INDUSTRIES, INC.
354 Oregon Ave. · Connersville, Indiana

Specialists in handling gas and air

granular solid materials potentially suitable for high-temperature fluidization were characterized according to their thermal properties and resistance to high-temperature attrition. Properties determining smooth fluidized bed operation were found to be particle size, particle size distribution, and bulk density, for materials of widely varying chemical compositions. The minimum superficial velocity necessary for complete fluidization was related to the screen analyses of the solids, and agreement between measured and calculated pressure drops through fluidized beds was satisfactory.

The oil gasification studies were carried out in a two-barrel per day pilot plant. Gasification yields were determined for several distillate and residual petroleum oils representing a wide range of characteristics. The operating variables considered were cracking temperature, residence time at temperature, partial pressure of oil gas leaving the reaction zone, and solids-oil feed ratio. Gasification yields and product properties were correlated with the oil properties and operating variables and are presented in graphical form. Thermal recoveries, product yields and oil gas compositions for the fluid gasification pilot plant are compared with laboratory tube furnace data used to formulate the basic correlations. It was found that the fluid gasification results conform with the basic

20 Water Main Taps Per Day
WITH ONE SHERMAN POWER DIGGER!

Because of the speed and ease with which trenches and holes can be dug by a Sherman Power Digger, Utility Installations Co. of Detroit has found a profitable sub-contracting business—digging to tap water mains and trenching for service lines into homes in new housing projects. Up to 20 bell holes for water main taps are dug by a single Sherman Power Digger in one working day. This performance is due to the easy handling of the all-hydraulic Sherman Power Digger—its flexibility, compactness and maneuverability. Combine these with Sherman's exclusive design features, simple maintenance and amazingly low initial cost . . . and you'll find that a Sherman Power Digger will fit into *your* operation profitably too! Write for free literature J11.

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Designed, Engineered and Manufactured Jointly by
SHERMAN PRODUCTS, Inc.
Royal Oak, Michigan
WAIN-ROY CORPORATION
Hubbardston, Mass.

•

Patent No. 2,303,825
Other patents pending

Sherman
PRODUCTS, INC.
ROYAL OAK, MICHIGAN

CALENDAR

March

1-5..American Society for Testing Materials Spring Meeting — Shoreham Hotel, Washington, D. C.

3..NEGA Sales Division, Boston Gas Auditorium — Boston.

4..NEGA Sales Division, Connecticut Light and Power Auditorium — Berlin, Conn.

4-5..AGA Gas Supply, Transmission and Storage Conference —Jung Hotel, New Orleans.

9-11..PCGA Technical Section — San Francisco.

15-17..Mid-West Gas Assn. Annual Meeting — Fort Des Moines Hotel, Des Moines, Iowa.

16-17..Gas Conditioning Conference — Extension Study Center, University of Oklahoma, Norman.

23-24..PCGA - AGA Domestic Gas Research & Utilization Conference—Ambassador Hotel, Los Angeles.

23-24..PCGA Domestic Research Conference — Los Angeles.

25-26..New England Gas Assn. Annual Meeting — Hotel Statler, Boston.

25-26..Oklahoma Utilities Assn. Annual Meeting — Biltmore Hotel, Oklahoma City.

April

7-8..PCGA Accounting Section — Berkeley, Calif.

12-14..AGA Sales Conference on Industrial & Commercial Gas — Edgewater Beach Hotel, Chicago.

12-14..National Conference of Electric & Gas Utility Accountants—Hotel Statler, Boston.

13-15..Southwestern Gas Measurement Short Course — University of Oklahoma, Norman.

15-16..National Personnel Conference of the Gas Industry—Edgewater Beach Hotel, Chicago.

19-20..AGA Residential Gas Section, Eastern Natural Gas Regional Sales Conference—William Penn Hotel, Pittsburgh.

19-21..AGA National Purchasing & Stores Conference — Henry Grady Hotel, Atlanta, Ga.

21-22..PCGA Technical Section, Customers Service — Santa Barbara, Calif.

20-23..AGA Distribution, Motor Vehicles, and Corrosion Conference—Mount Royal Hotel, Montreal, Canada.

22-23..Indiana Gas Assn. Annual Meeting — French Lick Springs Hotel, French Lick, Ind.

26-28..Mid-West Regional Gas Sales Conference — Edgewater Beach Hotel, Chicago.

26-28..Southern Gas Assn. Annual Convention—Houston.

May

10-14..AGA Commercial Gas School Chicago.

10-14..35th Annual National Restaurant Convention & Exposition — Navy Pier, Chicago.

10-13..LPGA Convention — Conrad Hilton Hotel, Chicago.

12-13..PCGA Gas Supply & Transmission — San Francisco.

13-14..Public Utilities Advertising Assn. — Hotel Statler, Boston.

17-21..National Fire Protection Assn.—Statler Hotel, Washington, D. C.

18-20..Pennsylvania Gas Association — Pocono Manor Inn, Pocono Manor, Pa.

19-21..GAMA Annual Meeting — The Drake Hotel, Chicago.

24-26..AGA Production and Chemical Conference — William Penn Hotel, Pittsburgh.

27-28..Natural Gas & Petroleum Assn. of Canada — Prince Albert Hotel, Windsor, Ontario, Canada.

June

1-3..Edison Electric Institute Annual Meeting — Atlantic City, N. J.

2-3..AGA Research & Utilization Conference — Hotel Statler, Cleveland.

20-24..Canadian Gas Assn.—Banff Springs Hotel, Banff, Alberta.

21-22..AGA Residential Gas Section, New York-New Jersey Regional Gas Sales Conference — Monmouth Hotel, Spring Lake, N. J.

28-29..Michigan Gas Assn.—Grand Hotel, Mackinac Island, Mich.

September

8-10..31st Mid-West Gas School and Conference, Iowa State College — Hotel Sheldon-Munn, Ames, Iowa.

8-10..Pacific Coast Gas Assn. — Victoria, British Columbia.

17-18..Maryland Utilities Assn., Fall Conference — Virginia Beach, Va.

28-29..Texas Mid-Continent Oil & Gas Assn. — Baker Hotel, Dallas.

October

7-8..California Natural Gasoline Assn. Annual Fall Meeting. Ambassador Hotel, Los Angeles.

11-13..AGA Annual Convention — Atlantic City, N. J.

18-22..National Safety Council — Chicago.

November

8-11..American Petroleum Institute—Conrad Hilton Hotel, Chicago.

Look...the New 40A

RIDGID

Tristand

with built-in folding tray

Tray pushes up easily to fold Tristand, pushes down easily to set up. Holds stand rigid.

Vise base overhangs front legs so threader handles swing clear. Perfect tripod and balance.

The Tristand you've been wanting. Now stand and tray all one unit—no loose parts. Extra-light weight, stronger more rigid than ever. Full size vise base—3 benders, ceiling brace screw, pipe rest, new tool-hanging slots. Designed for the utmost service for your money. See the new RIDGID 40 A Tristand at your Supply House! Immediate deliveries!

Folds up small as ever for easy carrying to job and it's extra lightweight.

THE RIDGE TOOL COMPANY • ELYRIA, OHIO, U.S.A.

RIDGID

Work-Saver Pipe Tools

high-Btu oil gas correlations presented in Research Bulletin No. 12 of this series.

Based on the operating experience with the pilot unit, characteristics of the fluid gasification process are discussed. Particular emphasis is placed on the problem of commercial equipment design. Methods of handling oil feed and its cracking products at high temperatures are considered, and comparisons with operating problems of the Thermofor Pyrolytic Cracking process are made.

PILOT PLANT CATALYTIC GASIFICATION OF HYDROCARBONS—IGT Research Bulletin No. 6.

This work reports the results of a pilot of hydrocarbons, in the presence of steam and air, as a method of producing substitutes for various types of utility gases, manufactured and natural. The hydrocarbons gasified in this study included natural gas, refinery oil gas, propane, butane, gasoline, kerosene, crude naphtha, and light gas oil.

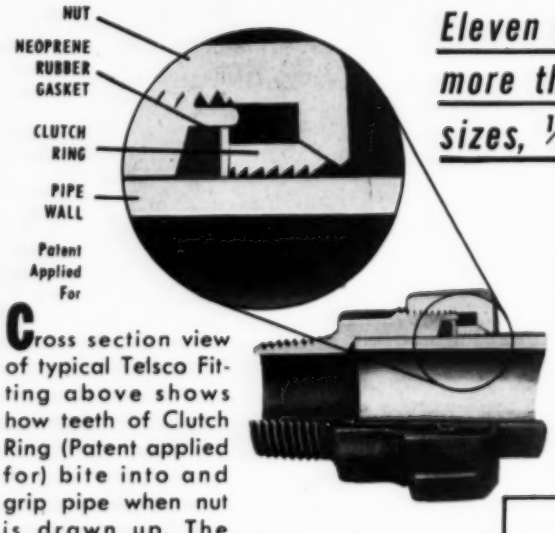
Data are presented on the effects of operating variables upon cracking results for these hydrocarbons, including the effects of preheat and catalyst bed temperatures, of space velocity and space-time yield, and of air- and steam-to-hydrocarbon feed ratios. The relative capacities as affected by hydrocarbon feed properties and the corresponding steam and air requirements are outlined on plant investigation of the catalytic cracking the basis of these data and compared with commercial operations. Commercial nickel catalysts, and one especially rugged nickel on alundum catalyst developed during the course of the study, were used, and the effects of carbon deposition, sulfur poisoning, and catalyst regeneration techniques on catalyst activity were evaluated.

The test data show that capacities and yields were both contingent upon heat transferred from the furnace to the catalyst bed. A theoretical study indicated that the quantities of heat transferred through the catalyst tube walls were dependent upon the mass velocities of the hydrocarbon-steam-air mixture passing through the tube, and that a high ratio of tube wall to catalyst volume was favorable to high capacities per unit catalyst volume. These theoretical conclusions were confirmed in the pilot plant tests by the increased yields per unit volume of catalyst when using small diameter tubes at increasingly higher mass velocities and preheat temperatures.

From computations based on the pilot plant results and interchangeability data obtained in field and laboratory tests, catalytic cracking of hydrocarbons of low molecular weight to produce a low heating value "carrier" gas, and subsequent enrichment of this carrier gas with natural gas or propane, is shown to be a means of providing base load substitutes or peak load supplements for utility systems distributing carbureted water gas, coke oven-carbureted water gas mixtures, natural gas, or manufactured gas-natural gas mixtures. Material requirements are listed for production of gases of desired composi-

Telsco

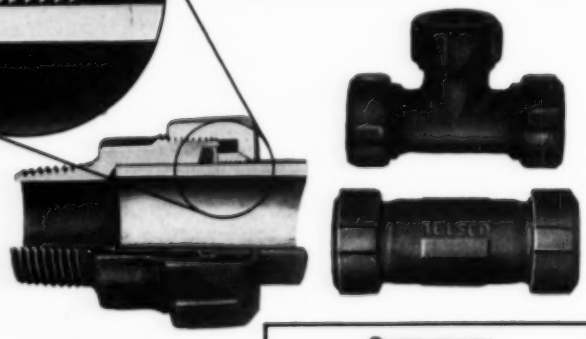
MALLEABLE IRON FITTINGS GET AND HOLD A BULLDOG GRIP ON STEEL AND PLASTIC PIPE



Cross section view of typical Telsco Fitting above shows how teeth of Clutch Ring (Patent applied for) bite into and grip pipe when nut is drawn up. The Neoprene Rubber Gasket, under pressure from the Clutch Ring on one end and the fitting body on the other, completely seals the connection against gas leaks.

Telsco Fittings are tested to hold at traction forces ranging from 1,450 to 3,600 lbs. They hold at hydrostatic forces ranging from 450 p.s.i. (on 2" pipe) to 8,250 p.s.i. (on ½" pipe)

Eleven different types, more than 100 different sizes, ½" through 2"



Metal Stiffeners

Telsco Brass Stiffeners to stop Thermoplastic "cold flow" are available to use with Telsco Fittings on Plastic Pipe. Stiffeners are split to allow for off-diameter pipe, and flared on one end to allow free flow through the connection.

Available in

Couplings (Long and Short); Adapters, 90° Elbows, Tees, Fitting Reducers and Fitting Increasers.

Literature

Complete information about Telsco Fittings: Ask for your copy of *Price List C*, just off the press.

TELSCO FITTINGS DIVISION
5422 REDFIELD STREET, DALLAS 19, TEXAS

View of the New Freedom Gas Kitchen that provided the plus value needed to put over Foothill Manor, a San Bernardino (Calif.) housing development, put on the market when the new home market was skidding. Merchandise tie-ins boosting the kitchens were under the direction of Owen L. McComas of Southern California Gas Co. Seventy-five sales were made in the first 10 days.

tions, specific gravities, and heating values.

The work was conducted by the Institute of Gas Technology, Chicago, under the sponsorship of the American Gas Association, with the cooperation and assistance of the Philadelphia Electric Co.

INVESTIGATION OF THE PRESSURE LOSSES OF TAKEOFFS FOR EXTENDED-PLENUM TYPE AIR CONDITIONING SYSTEMS—A report of an investigation conducted by the engineering experiment station at the University of Illinois in cooperation with the AGA and the National Warm Air Heating & Air Conditioning Association.

This bulletin is a combined report of two separate though closely related research projects which had to do with takeoffs for air duct systems of the extended-plenum type and which were conducted in the mechanical engineering laboratory under the terms of cooperative agreements between the engineering experiment station of the University of Illinois and two associations.

During the first part of the investigation, which was sponsored by the National Warm Air Heating & Air Conditioning Association, the objective was to determine shapes of takeoff fittings which not only would give good performance but also would be simple enough in construction to be accepted by the industry as standards.

For this purpose, a 7-in. diameter branch duct was connected to a 12-in. by 8-in. extended plenum by one of many experimental takeoffs. Twenty designs of side takeoffs and nine designs of top takeoffs were studied over a range of air-flow rates and their pressure losses determined. As a result of this part of the investigation, certain sizes and shapes of takeoffs were selected as desirable standards.

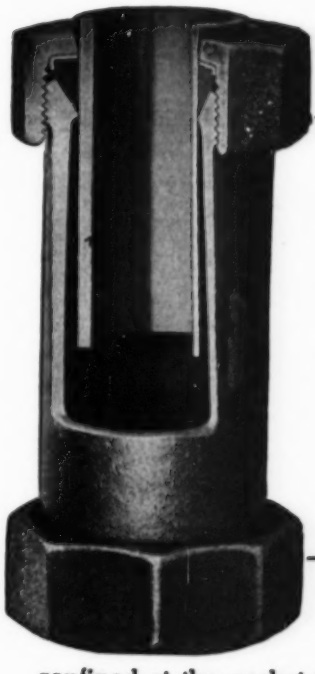
During the second part of the investigation, which was sponsored by the AGA, the objectives were (1) to determine the performance of several sizes of standard side and top takeoffs when installed on larger extended-plenums than previously used, and (2) to study the effect of the relative locations of two or more takeoffs on the pressure losses of individual takeoffs.

For this purpose, 24-in. by 8-in. and 24-in. by 12-in. extended plenums and 7-in., 8-in., and 9-in. diameter branch ducts, together with corresponding standard side and top takeoffs, were utilized.

The pressure losses of all takeoffs were found to be a function only of the ratio of the velocity in the branch duct to the velocity in the plenum just upstream of the takeoff.

The results also showed that the pressure losses of standard takeoffs (recommended commercial types) did not depend upon the size and shape of the extended plenum. Moreover, the performance of a takeoff was not affected by the relative locations of other takeoffs.

A practical interpretation of the results, as well as pressure-loss curves for design purposes, has been included.



NORMAC

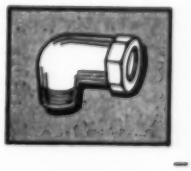
Couplings, Sleeves and Fittings

for maximum deflection, ease of "stabbing," complete confinement of the rubber!

So close are "Normac" rubbers confined at the gasket tip that possibility of flow is reduced almost to "nil." These couplings, sleeves and fittings . . . approved by gas utility men across the country for their time-saving features, ease of handling and dependable service . . . are available in a complete range of sizes. Made from air furnace malleable iron they provide greater wall thickness than pipe on which used.

NORMAC COUPLINGS are made with 5" centers in all sizes. NORMAC SLEEVES are identical in design except that they are made with 10" centers. Nuts and gaskets are interchangeable.

Compression-End Service "Tee"—First fitting of this type ever produced with full coupling depth and special threads on male end to prevent dropping into old hand taps when used to replace standard threaded fittings.



Compression-End Service "Ell" — Extra depth makes it possible to "stab" pipe into stops and without measuring, pull back a safe distance to allow ultimate deflection eliminating possibility of strain against tap in main.

Compression-End Iron Body Brass Core Service Stopcocks—End the necessity of threading on the job plus the elimination of the threads themselves—combining all the advantages of NORMAC COUPLINGS and the best in stopcock design. 2½" coupling depth on each end.

Normac Brass Fittings Developed in 1939 for Use with Copper Tubing—Our complete line of brass fittings can be used either on new installations or where copper is run through old steel pipe in large or small openings. The center to end dimensions of NORMAC TEES correspond with old malleable iron fittings. This feature is extremely important in the use of these fittings in one foot openings where the tubing must line up with the steel which has been removed.

Write for the NORMAC CATALOG of Gas Distribution Equipment

NORTON-McMURRAY MFG. CO.

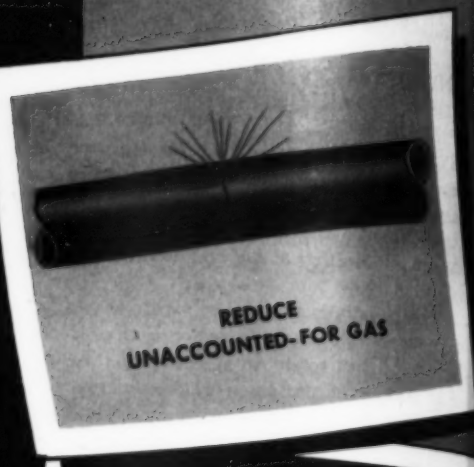
122 SOUTH MICHIGAN AVENUE - - - CHICAGO 3, ILLINOIS

Couplings • Motor Bars • Sleeves • Cocks • Ball Joint Clamps • Service Tees & Ells

FISHER®

. . . increases
outlet pressure
automatically
when load increases.

. . . decreases
outlet pressure
automatically
when load decreases.



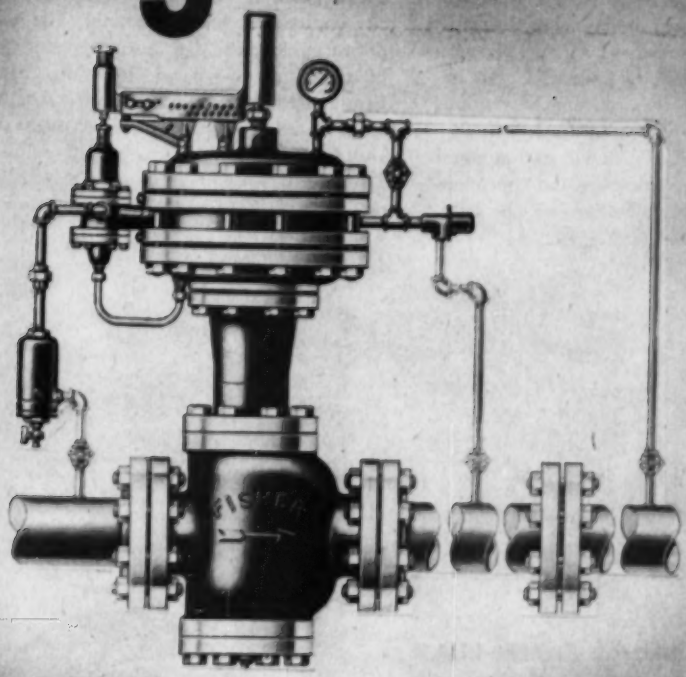
Many times the use of Fisher Boosters will eliminate the need of installing new, larger mains to handle increased loads.

FISHER®

King Booster

HIGH PRESSURE
FOR POUNDS TO POUNDS SERVICE

The Fisher King Booster is an entirely self-contained pressure controller. Requires no electrical wiring or remote telephone connections. It will maintain a constant pressure at the low pressure point in the distribution system regardless of demand load.

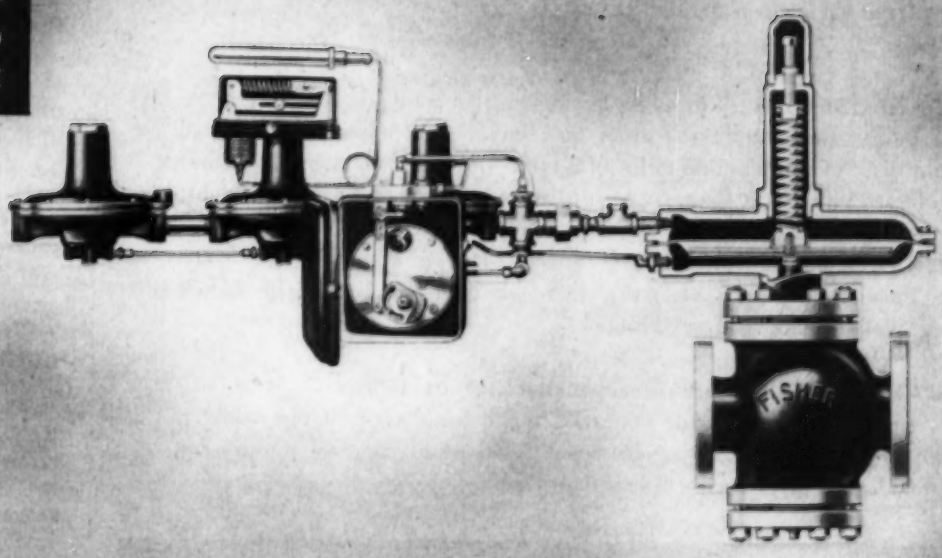


FISHER®

Time Temperature Booster

LOW PRESSURE
FOR POUNDS TO OUNCES SERVICE

As a district regulator the Fisher Time Temperature Booster will automatically increase the low pressure when the temperature drops to compensate for the increased load of residential heating. It automatically lowers the pressure during high temperature periods.



FISHER GOVERNOR COMPANY
MARSHALLTOWN, IOWA
LEADING THE INDUSTRY IN RESEARCH FOR BETTER GAS PRESSURE CONTROL

ASSOCIATIONS

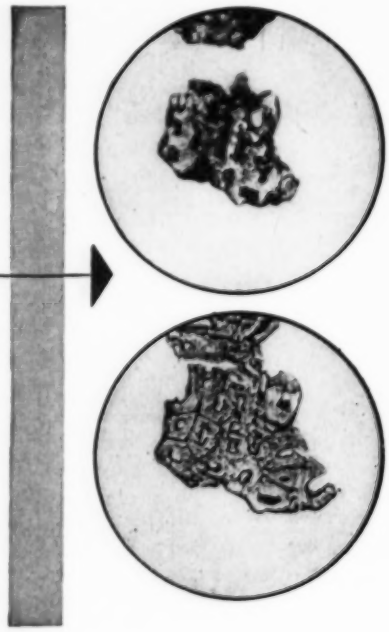
Two San Francisco sessions planned by PCGA sections

Two conferences of the Pacific Coast Gas Association will be held in San Francisco this month on succeeding days. The distribution conference, sponsored by V. W. Harper, Portland (Ore.) Gas & Coke Co., will be held March 9-10; the accident prevention conference, sponsored by Milford Springer, Southern Counties Gas Co., will start at noon on the 10th and run through the afternoon of the 11th. Both conferences will be held at the Fairmont hotel.

During the distribution conference, D. J. Robinson, Mountain Fuel Supply Co., Salt Lake City, will discuss interruptible loads; C. H. Webber, Tucson (Ariz.) Gas, Electric Light & Power Co., will speak on plastic pipe; and M. C. Nutter, Seattle (Wash.) Gas Co., will discuss ways and means of planning ahead through personal contacts with the city engineer and his personnel. The effect of heating loads on distribution pressure will be the subject of a panel discussion. George Fox, Coast Counties Gas & Electric Co., will speak on relief valve on customer meter sets, and C. C. Westmoreland and Gordon G. Dye, SoCal, will present committee reports on street use ordinance and public safety, respectively.

Subjects to be covered at the accident prevention conference include "Safety Procedures as Practiced by Pipeline Contractors," by L. F. Dishman, Pacific Pipeline Construction Co.; "Workmen's Compensation and Penalty for Serious and Wilful Misconduct," by Milford Springer; "Responsibility of Supervisors Under State Safety Orders," by A. C. Backman, chief of the California division of industry safety; "Psychological Factors in Accidents," by Prof. Edwin E. Ghiselli, University of California; "Selling Safety Through Supervisor Training," by R. E. Donovan, Standard Oil of California. A forum on accident prevention will also be on the agenda.

PROOF!



1. **CARBOSEAL** ANTI-LEAK
Trade-Mark

stops leakage due to dried-out fiber packing in bell-and-spigot joints.

PROOF: The dry jute fiber (magnified cross-section, top) swells as much as 44% when it's treated with CARBOSEAL anti-leak (bottom). In a joint all the fibers swell, openings between them close up, and leakage stops.

2. **CARBOSEAL** anti-leak gives lasting results.

PROOF: Distributors of dry gas have used enough CARBOSEAL anti-leak to treat 13,000 miles of 3-inch equivalent main. And the first joints treated with CARBOSEAL anti-leak—20 years ago—are still tight.

3. **CARBOSEAL** anti-leak is inexpensive.

PROOF: Cost of CARBOSEAL anti-leak to treat 1 mile of 3-inch equivalent main is about $100.

4. **CARBOSEAL** anti-leak is easy and economical to apply.

PROOF: Prove this for yourself. Write for a copy of our booklet, Form 4506 — also, our 16 mm. color-sound movie, "CARBOSEAL Anti-Leak," which we will lend you without charge.

CARBOSEAL ANTI-LEAK

Carbide and Carbon Chemicals Company
A Division of Union Carbide and Carbon Corporation
30 East 42nd Street UCC New York 17, N. Y.
In Canada:
Carbide and Carbon Chemicals, Limited, Toronto

"Carboseal" is a registered trade-mark of Union Carbide and Carbon Corporation.

Conference and exhibition planned by corrosion men

The 10th annual conference and exhibition of the National Association of Corrosion Engineers will be held in Kansas City, Mo., this month (March 15-19) in the municipal auditorium. More than 80 organizations will exhibit their wares.

Symposia will be held on corrosion principles, nondestructive testing, costs of corrosion, refinery, pipeline coatings, chemical industry, power and communication, cathodic protection, oil and gas production, elevated temperature corrosion, and protective coatings.

NACE officers for the 1954-55 term will be installed at the close of the conference. Aaron Wachter, Shell Development Co., currently vice president, will succeed Walter F. Rogers as president. F. L. Whitney Jr., Monsanto Chemical Co., is the new vice president and Russell A. Brannon has been reelected as treasurer. New directors are T. P. May, International Nickel Co.; Jack W. Harris, Beaumont Iron Works; and Harry R. Brough, Mountain Fuel Supply Co.

During the annual banquet, to be held March 17 at the Hotel Muehlebach, Dr. Irving A. Denison will receive the Willis Rodney Whitney award in recognition of his contributions to corrosion science, and E. H. Dix Jr. will receive the Frank Newman Speller award in recognition of his achievements in corrosion engineering.

Commercial water heater campaign gets under way

"Plenty of hot water pays—all ways!" is the theme of the 1954 commercial water heater sales campaign sponsored from February through April by the industrial and commercial gas section of the AGA. Hot water for dishwashing and sanitary purposes in large-volume feeding establishments will be pushed.

Coordinated sales efforts of gas companies, gas water heater manufacturers, and all dealers will be sought to place economical and efficient water heating equipment where it is most needed. Major attention will be de-

voted to checking with large-volume users to determine whether their hot water production facilities have become outgrown or outmoded. Further checks will be made to locate other reasons for hot water deficiency.

Promotional material for the campaign centers around a portfolio of sales helps and ideas promoting these appliances while also building commercial gas loads. Portfolio contents include mailing pieces for manufacturers, suggested letters to be sent to dealers, hotel, restaurant, and institutional feeding operators.

Sales promotion aid catalog available from AGA

The initial edition of the "1954 Catalog of the AGA Sales Promotion Aids" has been issued by the promotion bureau of the association. Illustrated are premiums, awards, and sales literature to stimulate gas promotions for the year.

The 32-page catalog should prove a handy reference and thought starter for premium and giveaway ideas for utilities and dealers planning promotions, sales campaigns, cooking schools, or other sales and public interest events. It implements all-year-round campaigns outlined in "The Gas Industry's 1954 Sales Promotion Plan Book."

AGA receives award for technical assistance

The Foreign Operations Administration and the Industrial Technical Assistance Division have presented the American Gas Association with a Certificate of Cooperation signed by Harold E. Stassen, who is director of foreign operations.

The award is for "furnishing technical assistance to the peoples of friendly countries" whose representatives visited AGA headquarters in New York, the Cleveland laboratories, and member gas utilities throughout the country.

Importance of home service brought out at workshop

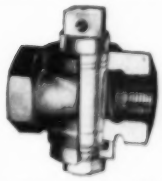
The importance of home service in the sales promotion programs of gas utilities was demonstrated effectively at the annual AGA Home Service Workshop held in Columbus, Ohio recently. More than 250 home service representatives from 31 states, the District of Columbia, and four Canadian provinces attended.

Mary E. Huck, general home service director of the Ohio Fuel Gas Co. and chairman of the home service committee, presided at the conference and acted as hostess to the visiting representatives. Miss Huck opened the meeting by pointing out not only the how and why of home service departments, but also telling the representatives "who" could do the best work in promoting sales of gas and gas appliances in the industry.

"Better get a quote from ECLIPSE"

. . . FOR FAST SERVICE ON GAS COCKS

STANDARD—Eclipse iron body brass core construction serves better, longer. Individually tested at 125 lbs. and guaranteed as to gas-tightness, accuracy and alignment of tappings.



"RETAINED KEY" — Tamperproof construction . . . offers in addition the assurance that key will not be blown from or pulled out of the body even though the lock nut is removed or the tail piece snapped off.

Both types available for immediate, partial shipment, in flat head or lock wing style, black or galvanized finish.

. . . COMPLETE STOCKS OF RIGID METER BARS

STANDARD UNION, with standard type, gasket or ground joint union. Simplify and speed setting, give maximum protection to the meter. ALSO AVAILABLE WITH INSULATED UNION.

SLEEVE UNION, with threaded, one-piece sleeve union connections . . . no gasket required. Soundness and accuracy guaranteed.

COMPRESSION TYPE has threadless connection for "stab fit" of pipe. Gives maximum protection, plus new speed, flexibility and low cost meter settings.

All types available with or without integral gas cock (standard or "retained key") in wide range of sizes and styles.

ECLIPSE FUEL ENGINEERING CO., ROCKFORD, ILLINOIS

ECLIPSE FUEL ENGINEERING CO. OF CANADA, LTD., TORONTO, ONTARIO

GAS COCKS — Eclipse — METER BARS

Write today for new Eclipse Rigid Meter Bar Bulletin, P-1; Gas Cock Bulletin, P-12.

Eclipse Fuel Engineering Co., 1109 Buchanan St., Rockford, Illinois

( ) Please send new Meter Bar Bulletin P-1
( ) Please send Gas Cock Bulletin P-12
( ) Please send samples for inspection and test.

Firm Name_____
Individual_____
Address_____
City_____ State_____

Approximately 60% of the delegates were freshmen, attending their first workshop.

School demonstrations and replacement programs for keeping school laboratories equipped with modern gas appliances were subjects of the first-morning program. Participating were Elizabeth Boyle, Minneapolis Gas Co.; Mrs. Marge Snouffer, Ohio Fuel; Mrs. Betty Headley, Savannah Gas Co.; Peggy Shaber, Oklahoma Natural Gas Co.; and Barbara Haller, Ohio Fuel Gas.

Other discussions centered about the Ohio Fuel Gas Co.'s Gasco Food Institute, a phase of the company's dealer cooperation program; club demonstrations; home service project symposium; commercial kitchens; the place of home service in promotion; telephone inquiries.

Some of the speakers at the workshop (from left): Ruth Beard, Ohio State University; Mrs. Barbara Haller, Marion Viall, Dorothy Farrell, Mildred R. Clark, and Eleanor Morrison.

ARCCO
BETA CHART PENS
...HOLD 2 to 4 TIMES MORE INK
Beta Fountain Pens hold two to four times the ink of ordinary chart inking pens. Regardless of the line thickness Beta Pens produce a smooth unbroken and uniform line. Pens shown are approximately actual size and can be arranged to reduce time interval between static and differential lines to only a few minutes. Beta Pens are especially suitable for seven day records. Price $1.10 (lower prices in quantities).
Send for bulletin No. 110.
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Purchasing and stores men to gather in Atlanta

Types of buyers, material handling, methods of taking inventory, systems of inventory control, traffic, coordination of purchasing and stores, and standardization are among the topics that will be discussed at the national purchasing and stores conference in Atlanta, Ga., April 19-21.

Among the speakers lined up by Pat H. Butler Jr., Washington (D. C.) Gas Light Co., who is chairman of the AGA purchasing and stores committee, are E. G. Plowman, United Steel Corp., who will speak on "Traffic"; J. S. Phillips, United Fuel Gas Corp., "Working Together"; and R. H. Bussard, Washington Gas Light, and A. H. Gannon, Transcontinental Gas Pipe Line Co., who will speak on "Inventory Control."

Committee reports will be made on standard packaging, reduced purchasing and stores costs, inventory taking, storeroom design, general vs. special buying, industry-wide standards, and recruiting, selection, and training of purchasing and stores employees.

ASHVE holds annual meet; elects Hunter president

Discussions ranging in interest from automobile air conditioning to the availability and utilization of solar energy for heating were on the agenda at the 60th annual meeting of the American Society of Heating & Ventilating Engineers, held in Houston recently.

The new ASHVE president is Louis N. Hunter, vice president of research and a director of the National Radiator Co. John E. Haines, Minneapolis-Honeywell Regulator Co., is 1st vice president; John W. James, McDonnell & Miller Inc., 2nd vice presi-

dent; E. R. Queer, Pennsylvania State College, treasurer.

For digests of some of the ASHVE papers, see page 66.

W. M. Riach Jr. heads Midwest industrial group

William M. Riach Jr., the Peoples Gas Light & Coke Co., Chicago, was elected chairman of the Midwest Industrial Gas Council when the group held its annual meeting in January. John C. Gurche, Panhandle Eastern Pipeline Co., Detroit, is vice chairman and Grover C. Lewis, Public Service Co. of Northern Illinois, Bellwood, is secretary-treasurer.

The spring meeting of the council will be held at the Faust hotel in Rockford, Ill., on May 20-21.

Midwest gasmen to gather in Des Moines

The 49th annual convention and meeting of the Mid-West Gas Association, scheduled for March 15-17 at the Hotel Fort Des Moines, Des Moines, Iowa, promises to be one of outstanding interest.

Among speakers, the association has on its program AGA President Earl H. Eacker, AGA Lab Director Edwin L. Hall, GAMA President Sheldon Coleman, and M. L. Trotter, president of the Liquefied Petroleum Gas Association.

In addition, Fred C. Danforth, of Central Surveys Inc., will speak on "Market Survey in Connection with the Gas Industry Development Program"; William Henderson, of Mueller Co., on "Safety As I See It"; and William Hertz, of the *Minneapolis Star and Tribune*, on "Development of the Williston basin."

Five-day meeting planned by New York safety council

Five days of conferences, aimed at reducing this country's annual accident toll of 95,000 deaths, nearly 10 million injuries, and an economic loss of $8.7 billion, will get under way April 15 at the Hotel Statler in New York.

Ten thousand safety experts are expected to attend the convention, which will have 57 meetings, covering virtually all fields of industrial, highway, home, school, and public safety.

Association notes

The Gas Conditioning Conference for 1954 (formerly the Gas Hydrate Control Conference) will be held at the Extension Study Center on the North campus of the University of Oklahoma on March 16-17.

James E. Pew, manager of the natural gas and natural gasoline department of Sun Oil Co., has been elected chairman of the National Committee for L. P. Gas Promotion, succeeding Lee A. Brand, Empire Stove Co., who has held the post since 1950. K. R. D. Wolfe, Fisher Governor Co., is chairman of the newly constituted executive committee, and H. Carl Sorby, Geo. D. Roper Corp., has been named to the promotional council as a GAMA representative.

Among a limited number of printed pieces to be cited by a jury of graphic arts experts as outstanding in its classification was the AGA's annual report for 1952, which won an Award of Special Merit from the New York Employing Printers Association. The report was on display at a recent Exhibition of Printing in New York, as were the AGA booklets, "A Public Relations Program for the Gas Industry" and "Market Research."

James F. Daly, assistant controller of Long Island Lighting Co., Garden City, N. Y., has been elected assistant treasurer of the AGA. Active in association affairs for many years, Mr. Daly has served on several committees, including general accounting, accounting employee relations, and accounting development service.

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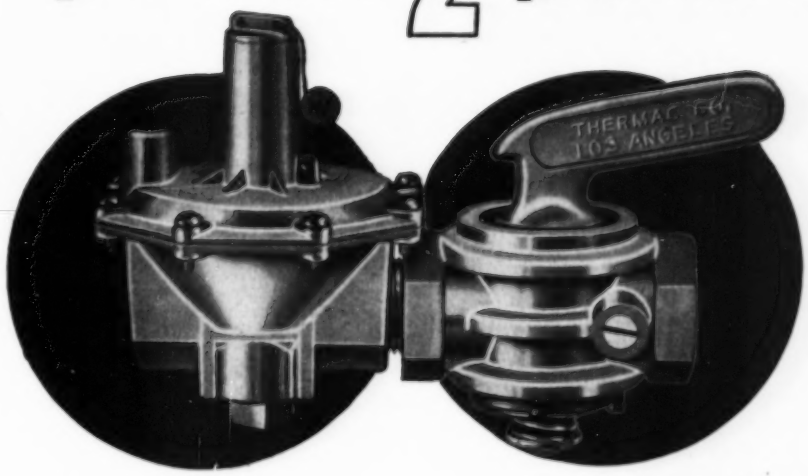

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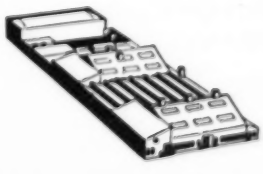

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Current Reading

FORMULAS FOR SELECTING PIPLINE DIAMETER FOR MINIMUM INVESTMENT — By George F. Downs Jr. and George R. Tait. This paper discusses the derivation and use of formulas which, when solved, give the size of pipeline required for transporting given quantities of liquid petroleum products at minimum investment. The formulas take into account the cost of the pipeline, the cost of pumping equipment, and the quantity and physical properties of the fluid to be handled. These variables are expressed as a function of pipe diameter so that, when proper values are assigned to them, the optimum size of pipe for minimum investment may be determined.

Alignment charts or monograms are included to aid in the solution of two of the formulas. This paper briefly discusses some of the pipeline flow formulas now in use. Examples are given of several typical solutions. Generalized cost information also is illustrated.

For additional information write the American Petroleum Institute, 50 West 50th St., New York.

HOT MACHINING OF METALS—Information Letter No. 57, prepared by J. H. Osterndorf, Brooklyn (N. Y.) Union Gas Co., for the AGA metals committee.

The committee believes that utility gas has not yet been applied as the heating medium for hot spot machining, which is still in the experimental stage. However, flame heating, using oxygen and acetylene, has been used successfully. Since other gases might be used with equal success, the committee believed it advisable to issue the information, meager as it is. No information on the subject was available from gas equipment manufacturers consulted.

The letter is available from the AGA, 420 Lexington Ave., New York 17.

A STUDY OF MORE EFFECTIVE USE OF SECONDARY AIR TO SUPPORT ATMOSPHERIC GAS BURNER FLAMES and A REVIEW OF LITERATURE ON THE RESULTS OBTAINED BY MIXING VARYING AMOUNTS OF OIL WITH INDUSTRIAL GASES BEFORE COMBUSTION AT ELEVATED TEMPERATURES —Both studies were sponsored by AGA research committees as PAR activities.

The first, Laboratories Research Report No. 1204, summarizes the findings to date and the exploratory methods used in the investigation. Data are developed which relate required secondary aeration for satisfactory combustion to such factors as input rate, primary aeration, burner design, and directing of secondary air into burner flame by means of baffle plates and secondary air passageways.

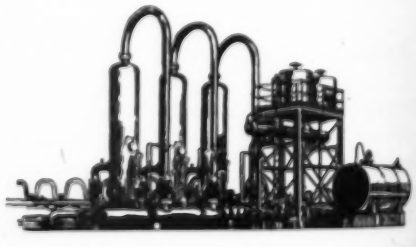
The second report presents an analysis and review of available literature of the facts affecting the heating of steel for forging in furnaces fired with gas-oil mixtures.

Copies of these reports are available for 75 cents each from the AGA, 420 Lexington Ave., New York, or the AGA Laboratories, 1032 E. 62nd St., Cleveland.

NATURAL GAS IN THE PACIFIC NORTHWEST—This source book by William Iulo is the most recent publication of the Bureau of Economic and Business Research at the University of Washington. It contains material on the potential markets that lie in the Pacific Northwest when natural gas arrives.

A partial list of chapter heads includes history and development of the natural gas industry; utilization of natural gas by commercial, domestic, and industrial users; the energy use pattern of the Pacific Northwest; and markets for natural gas in the area.

The 110-page, paper-bound book contains 14 figures and 43 tables and is available from the State College of Washington, Pullman, for $2.50.



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People

Promotions

E. F. Schmidt

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Lone Star Gas

Lone Star Gas Co., Dallas, has elected the following in a recent board action: Vice Presidents ELMER F. SCHMIDT and CHESTER L. MAY, senior vice presidents; L. T. POTTER, assistant to the president, executive vice president and new board member; MARSHALL NEWCOMB, general counsel and member of the board, became a vice president. Other new vice presidents are: JULIAN L. FOSTER, superintendent of transmissions; E. A. BROWN, manager of exploration and gas supply; M. L. BIRD, operating manager of the general division of distribution; W. F. WRIGHT, general manager of the Dallas division of distribution, and JOE C. DARROW, general manager of the Fort Worth division of distribution. TOM G. CROSS has been appointed manager of the company's tax department to succeed M. A. TRACY, who retired Dec. 31. He will be assisted by M. L. CLARK, FRANK E. WIESES, C. J. COLLIER, and B. L. CALDWELL.

M. Newcomb

L. T. Potter

Lone Star Gas

Mueller Co., Decatur, Ill., has announced the following changes: W. R. AUGUSTINE is central sales manager, a newly created position. ROBERT H. GAMBLE succeeds him as sales representative in eastern Michigan. A. D. PARKS, now southeast sales manager, is succeeded as sales representative in Delaware, Maryland, southern Pennsylvania, eastern Virginia, and Washington, D. C., by RICHARD C. SPONSLER, who is succeeded in western Pennsylvania by FRANCIS X. UHL. G. A. SMITH succeeds GEORGE WHITE, who is retiring, as sales representative in southern Illinois. ROBERT T. WHITEHEAD, who is retiring, is succeeded by ROBERT B. HERRIN in Missouri. RAY E. DE WEESE succeeds FLOYD V. JOHNSON in Tennessee, and ROBERT J. COPE takes over in Kentucky.

Continental Can Co. has named KENNETH B. GERRISH as director of sales and SIDNEY H. WILSON sales manager for the company's new Mills Plastic Pipe division, New York. The company has also appointed GERARD C. HELDRICH manager of the plastic bottle and plastic pipe plant in Chicago.

DR. ROGER ADAMS, well known chemist and educator, has been appointed to the board of trustees of Battelle Memorial Institute, Columbus, Ohio. He is head of the University of Illinois' department of chemistry and chemical engineering and has done considerable research on stereochemistry and natural products.

Arkansas Louisiana Gas Co. has merged the industrial sales department of its pipeline and distribution systems and named WILLIAM S. HYDE as senior industrial engineer of the new department. Other changes include reclassification of A. F. BURNS as chief industrial and commercial sales engineer, northern division, Little Rock; R. M. SCOGGINS as chief industrial and commercial sales engineer, southern division, Shreveport; also, DAVID C. DANIEL as industrial engineer,

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northern division; and HERBERT S. NORTON as industrial engineer, southern division.

A. S. CORSON, formerly comptroller, has been elected vice president in charge of finance and accounting, succeeding EDWARD PORTER, who was named senior vice president of the Philadelphia (Pa.) Electric Co.

In a major realignment of its engineering organization that consolidates related engineering activities in a new technical operations department, the Pittsburgh Group companies of Columbia Gas System have announced the following changes: H. R. WEITZEL, former superintendent of compressor stations, heads the new department; J. A. LOUDON is chief civil engineer; D. K. RUTH, communications engineer; R. L. WELCH, supervisor of gas measurement; H. W. GOODRICH, office manager. A. B. LAUDERBAUGH, head of the engineering department, has as his aides C. B. HEIST, senior gas engineer, and F. E. COSTANZO, corrosion engineer. G. G. DORMER is assistant superintendent of compressor stations; N. P. PEIFER is transmission corrosion engineer and P. N. KUZMICH is distribution corrosion engineer.

GEORGE W. STEVENSON has been promoted to manager of west coast operations for American Meter Co., where he will be in charge of the company's factories in San Francisco, Los Angeles, and Alhambra, and all of the company's activities in Washington, Oregon, California, Nevada, and Arizona. Mr. Stevenson, with the company for 26 years, was formerly general manager of the Los Angeles factory.

G. W. Stevenson

D. C. Holtz

American Meter

DONALD C. HOLTZ has been promoted to manager of the Nebraska City factory of the American Meter Co. He was formerly manager of the Dallas plant.

HOWARD A. PRAEGER, who has become assistant advertising manager of the New York State Electric & Gas Corp., Binghamton, has been succeeded as advertising manager of Brooklyn (N. Y.) Union Gas Co. by FREDERIC H. J. RIDER, who was formerly assistant manager of the publicity and advertising department.

Pacific Gas & Electric Co., San Francisco, has promoted HARRY A. LEE to San Francisco division manager, succeeding GROVER S. TRACY, who has retired. W. L. GREER, commercial manager of the company's Sacramento division, takes over as commercial manager of the San Francisco division, Mr. Lee's former position.

GORDON W. BEACHY has been appointed Sacramento division manager.

FREEMAN STRICKLAND has been elected to the board of directors of the Atlanta (Ga.) Gas Light Co.

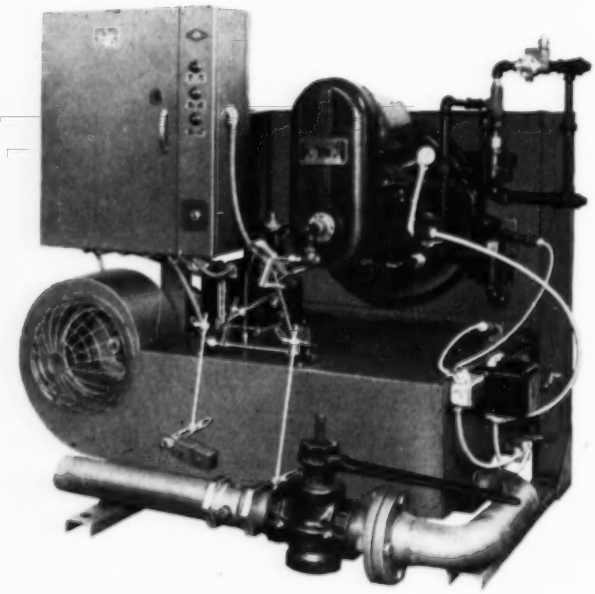
Lowell (Mass.) Gas Co. announces the following appointments: F. L. PUTNAM, chairman of the board of directors, and HARRY J. PATTERSON, a 25-year man with Lowell, president and director of the company. Mr. Putnam is president of F. L. Putnam & Co. Inc., investment bankers.

F. L. Putnam

H. J. Patterson

Lowell Gas Co.

WEBSTER ROTONETIC*



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- Sizes from 75 to 300 horsepower.
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- Maximum efficiencies on BOTH gas and oil.
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- Utilizes all grades of fuel oil.
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- Approved electronic combustion safeguard system.
- Simpler changeover than ever before.
- One hundred per cent forced draft.
- Completely assembled, piped, wired and tested.

These and many other outstanding features combine to provide the same dependable high quality performance as the WEBSTER DYNETIC gas burner. Neither fuel must suffer if the WEBSTER ROTONETIC is used. With integral pumps, integral oil preheaters for heavy oils, patented oil burner "flame-shaping" vanes, and full modulating or optional high-low control, the WEBSTER ROTONETIC is designed to provide long lasting customer satisfaction the year around.

It is furnished with a precast refractory front as an integral part of the burner assembly. The installer need only finish the furnace wall on each side and above the burner.

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G. W. EVANS, formerly vice president and general manager, has succeeded M. F. GILL as president of Kansas Gas & Electric Co. Mr. Gill will remain as chairman of the board and and chief executive officer.

Equitable Gas Co., Pittsburgh, has promoted J. FRANK SKIDMORE, transmission engineer, to assistant to the general manager, and CHARLES M. RUTTER, corrosion engineer, to chief corrosion engineer.

FRANK A. BURNS has been promoted to the post of public relations representative at Fairless Works of the United States Steel Corp. He has been director of public relations in the Pacific-Southwest district in Los Angeles.

MARY ELLEN JONES has joined the Santa Barbara (Calif.) division of Southern Counties Gas Co. as home service director.

HAROLD R. ZEAMER, formerly of the Philadelphia Gas Works, has joined the Richmond Radiator Co., Metuchen, N. J., as manager of the company's Philadelphia sales office, succeeding NORMAN ROWEN, who has resigned.

Upon his release from the U. S. Navy recently, D. C. MCDERMAND rejoined the sales staff of the home appliance division of Hamilton Manufacturing Co., Two Rivers, Wis.

FRED A. KAISER is the new executive vice president and a director of the Detroit-Michigan Stove Co., succeeding WENDELL L. SMITH, who has retired. Mr. Kaiser has been a vice president of the company since 1948.

D. M. KELLOUGH has been appointed merchandising manager of the Equitable Gas Co., Pittsburgh, in charge of the company's base load merchandising operations.

Panalarm Products Inc., Chicago, has named HOWARD W. HUDSON vice president in charge of the company's engineering and production activities.

Servel Inc., Evansville, Ind., announces the following appointments: H. R. NIELSEN, manager of the air conditioning division; NEAL E. SCHUMAN, field sales manager; ROBERT R. CLARKE, district sales manager, Houston area; C. A. STOCKHOFF, district sales manager, St. Louis territory; and ALLEN E. APPLE has been placed in charge of the company's personnel departments.

The gas division of New England Electric System announces the following personnel changes: Wachusett Gas Co.: WILDER MOORE, manager, and ROBERT E. MAGUIRE, superintendent. North Shore Gas Co.: ERNEST A. BULPETT, assistant manager of sales activities; LEROY S. MOORE, local manager; and JOHN J. LANGAN, executive assistant. MALCOLM C. MACAULEY was appointed assistant manager of Norwood Gas Co.

American Car & Foundry Co., New York, has appointed CHARLES C. GALLICANO assistant to the president. The following changes were made in the western sales area: JOHN H. VAN MOSS, sales consultant with headquarters in Chicago; ELLSWORTH B. CARPENTER, sales manager at St. Louis, and JOHN E. ANGST, district sales manager at Chicago.

The Mississippi Valley Gas Co. has announced the promotion of HAROLD E. JAMES as Jackson district distribution superintendent. He succeeds the late D. H. CRAWFORD.

V. M. MARQUIS has been promoted to vice president and assistant to the president of American Gas & Electric Service Corp. S. N. FIALA has been named chief engineer.

Latest promotions at Le Roi Co.'s Milwaukee Works include: LOUIS DONDERO, assistant works manager; RALPH L. BREZINSKI, production manager; ROBERT D. ANDERSON, assistant production manager; and JAMES HARWOOD, sales engineer, Transco division.

United States Pipe and Foundry Co. has established a Los Angeles office in charge of GEORGE J. BOGS, formerly of the Chicago office. He will be succeeded by L. C. KRU-

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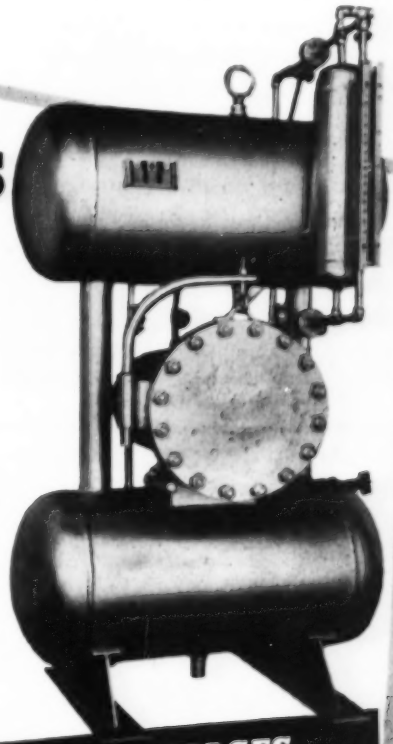
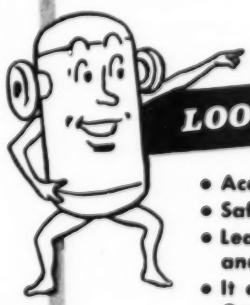
ODORIZER UNIT

The Peerless Type "MP" Odorization Unit has been designed to provide a complete odorization setup which is easily installed. This odorizer utilizes the Patented Peerless principle of liquid odorant injection.





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- It occupies a minimum of space. Only one foundation needed.
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MIDLAND, TEXAS
MOBILE, ALABAMA
ST. LOUIS, MISSOURI
NEW YORK, NEW YORK
OMAHA, NEBRASKA
COLUMBIA, SOUTH CAROLINA

SEN. ROBERT N. PARK is northwestern sales agent at the company's new office in Seattle. J. PERRY EMERSON heads the new Syracuse, N. Y., office, and BUDDY AMIS has been named sales representative at Houston.

The following new management posts in western Pennsylvania have been announced by Rockwell Manufacturing Co.: WILLIAM T. KIEHL JR., assistant to the executive vice president, and succeeding him as general manager is W. M. CONNOR. Formerly production manager at DuBois, EARL HUDSON has been named assistant general manager of that division.

Ebasco Services Inc., New York, has appointed W. H. MCINNIS as manager, and M. G. KENNEDY as assistant manager of the company's sales marketing and public relations department.

Northern States Power Co., Minneapolis, has elected JOSEPH A. BUSCH to a vice presidency and PAUL D. AUSTIN to assistant to the vice president in charge of sales.

HENRY G. EISEMANN, vice president and treasurer of Seaman & Eisemann Inc., has been elected a director of Long Island Lighting Co., Mineola, N. Y., to succeed the late COL. CHARLES G. BLAKESLEE.

T. H. Jeffers
Robertshaw

R. W. Campbell
National Pipe Coatings

THOMAS H. JEFFERS, formerly chief engineer, has been promoted to assistant general manager of the Anaheim (Calif.) division, Robertshaw-Fulton Controls Co. and elected assistant vice president.

Transfers

The appointment of R. W. (DOC) CAMPBELL as general sales manager of National Pipe Coatings Inc., Huntington Park, Calif., has been announced by President Raleigh P. Nelson. Mr. Campbell has been widely known in the gas industry for the past 30 years.

EDWIN B. FREDERICK has joined the Janitrol domestic-commercial division of Surface Combustion Corp., Toledo, as sales representative in the central Jersey territory, operating out of New York.

Honors

CARROLL C. PIKE, comptroller of Washington (D. C.) Gas Light Co., has been appointed chairman of the registration com-

mittee for the Eastern Spring Conference of the Controllers Institute of America.

F. MARION BANKS, president and general manager, Southern California Gas Co., Los Angeles, has been elected vice president of the Los Angeles Chamber of Commerce.

EUGENE J. HOUDRY has been presented with the John Scott Medal Award by the board of directors of City Trusts in the Philadelphia Engineers Club in recognition of his achievements in the catalytic cracking of petroleum. He is the founder of Houdry Process Corp., Philadelphia.

NORMAN R. SUTHERLAND, vice president and general manager of the Pacific Gas & Electric Co., San Francisco, has been elected a director of the California State Chamber of Commerce.

HOWARD F. MOORE, vice president of the Republic Light, Heat & Power Co., has been elected a director of the State Bank of Kenmore, Buffalo, N. Y.

ALBERT S. CORSON, vice president of Philadelphia (Pa.) Electric Co., has been elected to the board of directors of the Provident Trust Co., Philadelphia.

Deaths

JOHN L. CONOVER, retired general commercial manager of Public Service Electric & Gas Co., Newark, N. J., died in January at the age of 74. In 1930, he received the American Gas Association's Charles A. Munroe award for the "most outstanding contribution during the year in the general interest of the gas industry" for his accomplishments in the field of machine accounting. He retired from Public Service in 1949 after more than 41 years of service.

JOHN R. FARMER, 55, controller of the Central Hudson Gas and Electric Corp., Poughkeepsie, N. Y., died recently. He had been associated with the corporation for 34 years.

A. J. BIARD, who retired Jan. 1 as assistant secretary-treasurer of the Texas distribution division of United Gas Corp., Houston, died recently. He had been ill only a few days.

HAROLD L. MASTEN, 57, who has been associated with Central Hudson Gas and Electric Corp., Poughkeepsie, N. Y., for 24 years, died recently.

RALPH A. CAYLOR, 60, Janitrol division district manager of Surface Combustion Corp. in Indianapolis, Ind., died Jan. 10 after an extended illness.

HARRY B. HART, chief engineer of the Michigan Consolidated Gas Co., died recently in London, Ontario.

TOM GIBBONS, director of advertising and sales promotion, Coleman Co., Wichita, Kan., died recently at the age of 40 as the result of injuries suffered from an automobile accident.

OLIVER H. SMITH, 64, associate manager of gas production activities of the Consolidated Edison Co., New York, died late in January of a heart attack.

CHARLES J. RAMSBURG, retired senior vice president of the Koppers Co., Pittsburgh, who was a pioneer in the development of by-products from coal and gas, died recently at the age of 76.

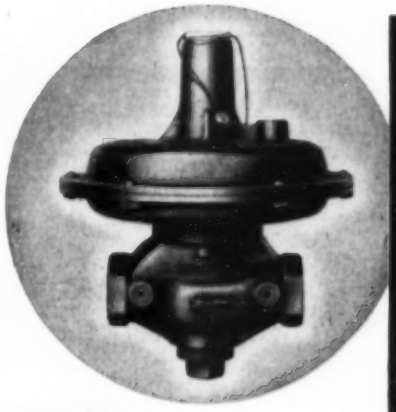
JAMES A. WARD, president of the California-Pacific Utilities Co., San Francisco, died last month after a long illness. He was 73 years old. Mr. Ward organized the Republic Service Power Co. in 1930, which was reorganized as California-Pacific in 1938.

D. BIRNEY STOKES, who retired as vice president in charge of sales for the United States Pipe and Foundry Co. in 1952, died recently. He had been with the Birmingham, Ala., firm since 1910.

B. F. BRAHENEY, 61, president of Northern States Power Co., died early in January following an illness of several months.

Steady

REYNOLDS LOW PRESSURE REGULATORS



PIPE SIZES:
¼" to 8"
¼" to 3" with screw connections
3" to 8" with flange connections

REPRESENTATIVES:
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Reynolds Low Pressure Regulators guarantee steady, constant, unvarying outlet pressure even though the volume varies and inlet pressure fluctuates. Precision built and delicately balanced for accurate performance on low pressure installations, the units illustrated are backed by factory tests over a wide range of operating conditions. Reynolds Low Pressure Regulators are economical and safe. Our Engineering Department is at your service.

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A simple device for cathodic protection work designed particularly for personnel installing insulating flanges, swivels, Dressers, etc., so that insulating joints can be left insulating by installer. Uses continuity lamp and compass. Works in manifolds. Uses standard flashlight cells not furnished.

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Use Rectorseal #2 on threaded connections in service lines, meter loops, appliance connections, swing joints, and all others on lines carrying natural or manufactured gas. It holds odorants, too! Compare Rectorseal #2 quality and price with any other thread compound, and you'll see why so many utilities are changing to this dependable, positive, economical, leak-proof thread sealing compound.

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When
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Are Used

- Eliminates Suction Hazards.
- Stops Back Pressure.

The lower valve prevents suction from going beyond valve.

The upper valve prevents any back pressure from entering gas line.

Both valves are soft seated for positive shut off.

Sizes from ½" to 6".

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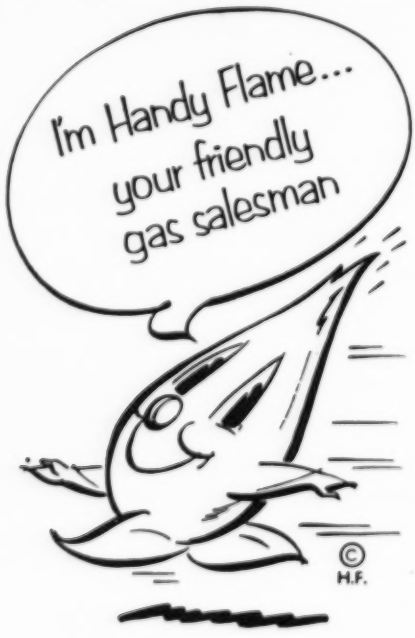
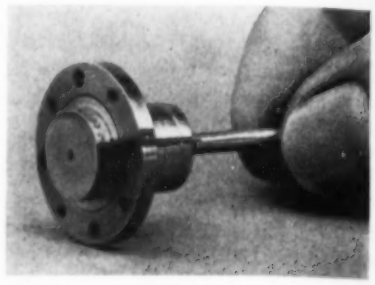
NORWALK VALVE COMPANY
South Norwalk, Connecticut



Put new life into your entire sales program. Put friendly Handy Flame to work in your ads, displays, direct mail, TV and radio programs, home service activities, novelties, etc. Now used by 36 gas companies. Complete utility service one-half cent per customer per year. $25 minimum. Satisfaction guaranteed. Write for details and free idea file. Handy Flame Service, P. O. Box 302, Indianapolis 6, Ind.

New Products and Trade Literature

To secure further information on products or new literature, simply fill out the coupon on page 100 and mail, indicating by number the information or literature needed.



1 Pressure Pickup

Consolidated Engineering Corp.'s new electrical resistance type pressure pickup provides immediate response to pressure changes where rapid pressure transients occur. Available in gauge, absolute, and differential models, it may be used for either liquid or gaseous measurement.

Since either a.c. or d.c. may be used for excitation of the internal bridge, these pickups can be used in a wide variety of controling, indicating, recording, and telemetering applications. Temperature compensation insures accurate and reliable performance from —65° to 250° F.

Consolidated Engineering Corp.

■

2 Home Incinerator

A new dual-action home incinerator produced by Detroit-Michigan Stove Co. combines both dehydration and fast-burning methods of waste disposal. When the dehydration system is used, refuse is subjected to constant heat at the rate of 1500 Btu/hr. For extra large quantities of waste, the fast-burning principle may be employed with its output of 10,000 Btu/hr.

The new Detroit Jewel incinerator is equipped with an automatic two-hour timer,

which automatically returns the operation to dehydration flame at the end of the set time. In addition, the new unit employs a "tinderizing" process in which refuse is dried by the passage of warm air through the waste material to hasten combustion. Down-draft operation provides extra drying action and reduces exterior temperatures.

Detroit-Michigan Stove Co.

■

3 Air Tools

The Davey Compressor Co. has introduced a new line of contractors' air tools. Paving breakers (model DB-90 shown) are now available in four sizes from 35 to 90 lb; backfill tampers come in 32- and 45-lb types; and rock drills include four models in sizes from 28 to 58 lb. The newly designed tools are streamlined with perfect balance and can be used for long periods with minimum operator fatigue. They possess greater parts interchangeability than any previous tool line, which reduces repair and maintenance costs.

Davey Compressor Co.

■

4 All-Purpose Gauge

A new I-V gauge that is claimed to serve as an air filter gauge, static pressure indicator, draft gauge, air velocity meter, etc., has been introduced by F. W. Dwyer Manufacturing Co.

Designed for plus, minus, and differential readings, the new gauge is equipped with a plunger type oil level adjuster. Ranges are 0-3 in. and 0-7 in. water, with a low range accuracy of .01 in. water. It is also available in a direct reading velocity model for use with a pitot tube; ranges 0-7000 and 0-10,-500 ft per minute.

The new gauge, furnished with tubing and fittings, comes in a molded plastic housing.

F. W. Dwyer Manufacturing Co.

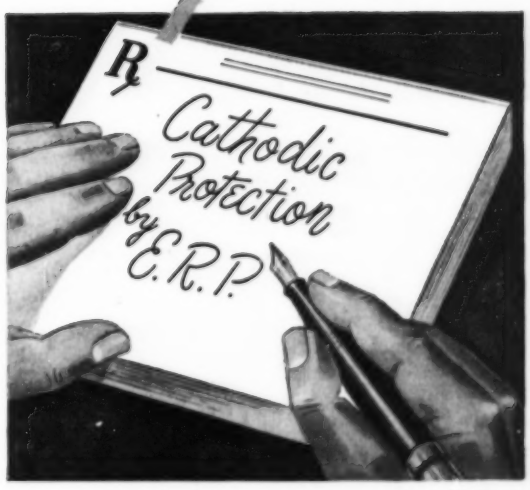
5 Gas Incinerator

A four-model line of gas incinerators has been introduced by Duo-Therm division of the Motor Wheel Corp. Included in the line are fully automatic models using any type gas, a safety-pilot model using either city or L. P. gas, a manually controlled model using city gas, and a conversion model that is sold without controls.

All units feature two-bushel capacity and Duo-Therm's direct-fire target-jet burners. The fully vented incinerators, with 15,000-

℞

FOR CORROSION...



You don't need a specialist to *recognize* Corrosion. But you do need one to treat it successfully. The skill required to achieve complete corrosion control comes only from the knowledge and experience gained through years of practical application.

Recognition of that fact is one reason more and more people are turning to E.R.P. for assistance on corrosion problems — one reason that thousands of buried or submerged steel structures of all types have been successfully protected against corrosion by E.R.P. engineers. Corrosion specialists *for over 17 years*, these men are highly trained and well equipped to help you with *your* corrosion problem. Write for full information today.

COMPLETE CATHODIC PROTECTION SERVICE • DESIGN ENGINEERING MAINTENANCE INSTALLATION EQUIPMENT

ELECTRO RUST-PROOFING CORP. (N. J.)

BELLEVILLE 9, NEW JERSEY

REPRESENTED IN PRINCIPAL CITIES IN THE UNITED STATES

E-27

GAS CLASSIFIED

Classified advertising is set in 6-point type, without border or display, at the rate of 15 cents per word per insertion; minimum charge per insertion $3. Box numbers for replies count as 5 words. Count as a word each one letter word and each group of figures. Classified advertising is only accepted when payment accompanies order. Copy and payment must reach publisher's office prior to 10th of month preceding publication.

WANTED — Industrial and commercial heating engineer for a natural gas utility. Donovan, Incorporated, 1725 Carroll Avenue, St. Paul 4, Minnesota.

Manufacturer's representative now calling on West Coast utilities interested in representing additional manufacturers of non-conflicting product. Warehouse facilities available. Box 35, GAS, 198 S. Alvarado St., Los Angeles 57, Calif.

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Btu input, are designed for either indoor or outdoor operation.

Duo-Therm Div.

■

6 Commercial Range

New features and technical improvements have been incorporated in a new line of Silex commercial gas ranges. Available in two-, three-, and four-unit styles, the new models have cast iron burners and range bodies that are snap removable to eliminate dismantling of range connections for service. Pilot lights are easily accessible without removing the range top, and burners are adaptable to natural, manufactured, or L. P. gas.

Silex Co.

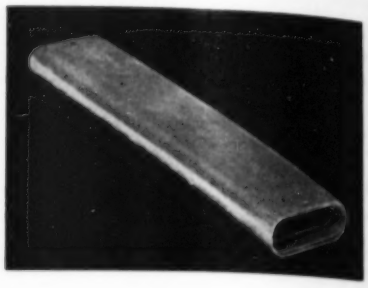
■

7 Power Drive

A new power drive for hand pipe tools, the Featherweight Champ, has been introduced by Oster Manufacturing Co. Weighing only 75 lbs, the threading machine has an over-all height of slightly more than 18 in. The machine has a threading range of ⅛ in. to 2 in. Spindle speeds are 22 to 36 rpm variable with load.

Oster Manufacturing Co.

■



8 Gas Vent Pipe

Featuring an inner and outer pipe separated by an insulating air space, a new William Wallace gas vent pipe has been designed especially for in-the-wall venting. Called WV Metalbestos, the pipe has a narrow, oval cross-section, permitting easy installation inside a wall without extensive special construction or extra insulation.

A new Fastloc coupler enables pipe sections to be joined without cement or mastic, and without screws except where the vent will be left exposed in rooms or attics. The outer pipe is galvanized steel and aluminum is used for the inner pipe.

William Wallace Co.

■

9 Automatic Boiler

A completely automatic boiler for radiation, convection, baseboard, and radiant panel heating systems is being manufactured by Bryant Heater division.

Manufactured in nine different capacities from 67,500 to 315,000 Btu/hr, Model 26 features finger-tip pilot ignition, the Safety Sentinel automatic pilot. The boiler is designed for installation in basement or utility room corner or in small closets.

A lung-like "magic action" valve assures proper flow of gas, promoting maximum economy and efficiency of operation. Bryant-designed cast iron burners and steel heating together with special glass fiber jacket insulation are incorporated.

Bryant Heater Division

■

10 Gas Clothes Dryer

Hamilton Manufacturing Co.'s 200 series dryer for 1954 utilizes an abbreviated aluminum escutcheon with maroon trim on the

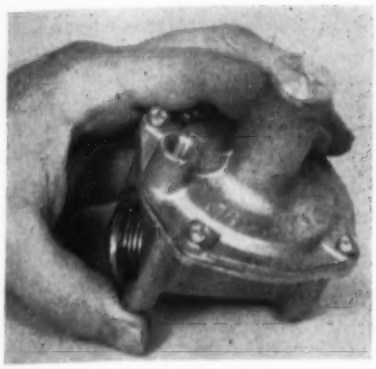
control panel and features a solid, positive-catch dryer door.

Model 260G has the patented carrier current air circulation clothes drying system, which cradles clothes in a gently moving stream of warm air. The dryer drum is zinc coated steel with three baffles slanted at angles that assure tumbling of small items.

The Fabri-Dial temperature control, which automatically selects the correct heat temperature for any fabric, is featured. The Hamilton timer permits 130 minutes of drying time for special projects like pillows and shag rugs. A double pass lint control method is located in the front of the dryer. Exhaust passes through the lint trap twice for maximum efficiency.

Hamilton Manufacturing Co.

■



11 Gas Pressure Regulator

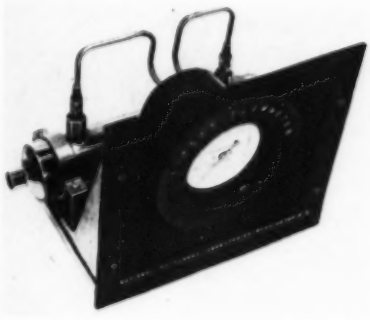
A new gas pressure regulator has been designed for Maxitrol Co. for use primarily on domestic ranges, water heaters, floor furnaces, wall and room heaters, low-capacity central heating furnaces, and industrial burner pilot controls.

It is designed for normal operation with a vent breather hole that will pass less than 1 cfh in case of diaphragm failure. In many cases it eliminates the necessity of a separate vent leak limiting device and vent tubing.

Application on ranges is particularly suitable because the regulator is capable of controlling pilot flows only when all the burners are shut off, yet still has adequate capacity for the full range input.

Maxitrol Co.

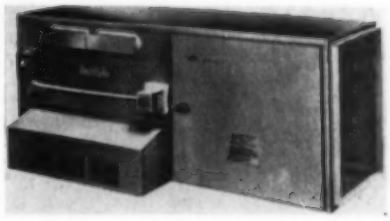
■



12 Flowmeter

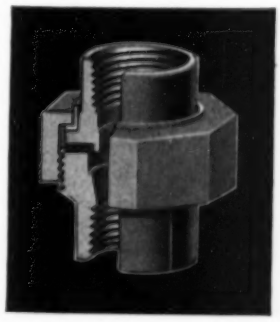
The new Model 30 Vol-O-Flo is a dial indicating gas flowmeter. Designed for measuring the rate of flow of gases at pressures up to 20 psig, it consists of a differential pressage gauge across a linear pressure drop flow element. For vacuum service, it is operable to absolute pressures as low as ½ psig (suction of 28 in. of mercury). Special attention has been given to designing for semi-remote applications in which the indicator is used several feet distant from the flow element. Neither the flow element nor the indicator require leveling. The use of a mechanical differential pressure gauge makes it possible to operate the flowmeter over the temperature range from —60° F to +180° F. Full scale flow ranges are available from 0.003 to 30 cu ft per minute for most gases.

National Instrument Laboratories Inc.



13 Horizontal Furnace

New gas-fired horizontal furnaces in 85,000, 100,000, and 140,000-Btu sizes from Coleman Co. may be installed in attics or suspended from the ceiling, or in the crawl space of basementless homes. To further increase adaptability, the units are designed



New CRANE Malleable Iron Insulated Union

Gives cathodic protection at meters—Galvanic corrosion in service piping can be effectively reduced by cathodic protection at meter connections. This rugged, malleable iron Crane union breaks the current path by means of special insulation.

Between union ring and tail-piece there's an L-shaped washer of laminated phenolic thermosetting plastic. Between tail-piece and thread-piece a thick black rubber gasket breaks the metal-to-metal contact. Both insulating parts have high dielectric strength.

New union measures just slightly longer than the regular ¾-inch Crane malleable union—approximately 2-7/32 inches, end to end. Packaged in cartons of 30.

Check your Crane Representative on these items!

New ¾-inch Safety Vent Elbows

A flexible stainless steel coil spring takes the place of the old bar grille or rigid screen in this new Crane vent elbow. Keeps out bugs, insects, foreign matter. Flexes outward if regulator is vented. Durable, dependable —die cast of zinc alloy.

CRANE

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois
Branches and Wholesalers Serving All Industrial Areas

for the THRIFTY BUYER

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

with interchangeable parts so flue outlet and controls are accessible from either side.

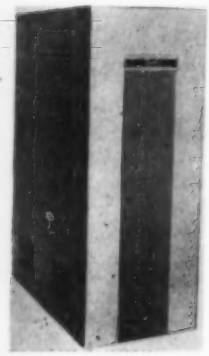
Air delivery is fully adjustable to the requirements of conventional, perimeter and Coleman Blend-Air small pipe and blender systems. The combustion chamber is a series of airfoil-shaped, heavy-gauge metal tubes positioned above a cast iron slotted port burner.

Standard controls include room thermostat, solenoid valve, gas pressure regulator, Baso 100% pilot shutoff, manual valve, fan switch, and limit control.

Coleman Co.

■

14 Cooling Unit



A direct-fired gas cooling unit that can be connected to existing forced-air gas furnaces to provide all-season comfort is the latest addition to Servel's air conditioning line.

Requiring only 8.7 sq ft of floor space, the new unit's 2-ton capacity will meet the cooling needs of most average homes, offices, and smaller business places. The absorption type refrigeration system is used in the cooling unit and a simple gas flame produces the cooling effect —without motor or moving parts.

Servel Inc.

■

15 Air Conditioner

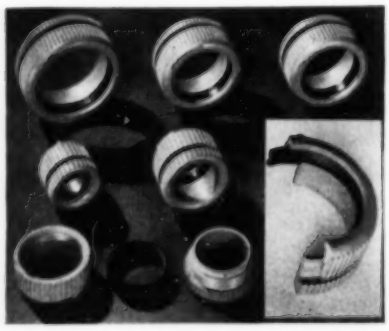
A versatile year-round air conditioner—a combination heat-cooling unit in one package—will be introduced by A. O. Smith Corp. soon. The cooling unit will be built for A. O. Smith by Worthington Corp. and will be housed in a modification of Smith's present warm-air furnace line.

The air conditioner and furnace combination will be available in either gas or oil-fired models and with either two- or three-ton cooling capacities. It is possible to convert the basic gas-fired unit to any one of four combinations by adding two separate cooling packages of either size along with the oil burner conversion package. With this, it is possible for a customer to start out with just the heating unit, then add the air conditioner at a later date.

Other features of the new air conditioner include a water-cooled condenser system and the "Magic Heet" burner.

A. O. Smith Corp.

■



16 Plastic Clamp

A molded plastic clamp has been developed by Carlon Products Corp. which is utilized to effect a tight, permanent seal when sections of flexible plastic pipe are connected by means of insert couplings, tees, ells, and adapters. It is slipped over the pipe ends and tightened to force them down onto the serrations incorporated in insert fittings to create a positively leakproof connection.

The new clamp is molded in two separate threaded sections. Butted against a shoulder at the base of the female threads in one half is a synthetic gasket with a V-shaped groove. When the other half of the clamp is screwed down onto this gasket, it is forced against the pipe, exerting a full 360° pressure on the pipe.

The Carlon clamp is produced in sizes for ½-, 1-, 1½-, 2-, 3-, 4-, and 6-in. plastic pipe.

Carlon Products Corp.

Trade Literature

17 Rotary Pump Catalog

A loose-leaf catalog from Viking Pump contains the company's current bulletins on its entire line of rotary pumps. Pumps covered include those for sanitary purposes, hazardous liquids, hydraulic, oil industry, fuel oil burner, idler drive, and heavy duty. In addition, pumps for special applications are described and engineering data and dimensions are presented.

Viking Pump Co.

■

18 Filter Bulletin

Staynew automatic filters designed for large air volume and high efficiency are described in a new 12-page illustrated bulletin from the Dollinger Corp. The bulletin contains specifications, engineering, and performance data covering automatic filters in a wide range of sizes for handling any desired air capacity.

Dollinger Corp.

■

19 Unit Heater Catalog

U. S. Air Conditioning Corp.'s new 12-page technical bulletin describes the company's complete line of Series 23A gas-fired unit heaters. Capacity tables and roughing-in dimensions, as well as structural and operational descriptions of the entire line, are included.

U. S. Air Conditioning Corp.

■

20 Sensing Unit Data Book

A 42-page data book and catalog from Wheelco Instruments Div., Barber-Colman Co., presents a complete line of thermocouples, radiation detectors, and resistance bulbs. The catalog contains information on various sensing units as well as on instrument servicing. Protection tubes, lead wire, and other accessories for use with indicating, controlling, and recording instruments are also covered.

Wheelco Instruments Div.

■

21 Thermocouple Bulletin

Complete physical properties, dimensions, and catalog order numbers are included in a new bulletin describing a metal-ceramic thermocouple well manufactured by the Bristol Co. The bulletin outlines all properties and specifications of the new protection tube, which combines the thermal conductivity and shock resistance of metal with the corrosion and deformation resistance of ceramics.

The Bristol Co.

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GAS, 198 S. Alvarado St., Los Angeles 57, Calif.

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Wellhead-to-city gate topics scheduled for expanded transmission conference

THE second AGA gas supply, transmission, and storage conference, which in some measure replaces the former spring conference of the AGA natural gas department, will be held at the Jung hotel in New Orleans, March 4-5. The newly named conference will offer general sessions devoted to such subjects as communications, compressor stations, large volume gas measurement, pipelines, and underground storage, and will extend the range of interests back to the gas wellhead for the first time.

Expanded coverage of the entire industry will be evident during the first general session, chairmanned by Grove Lawrence, Southern California Gas, when C. L. Perkins, El Paso Natural, will discuss "Drilling Wells with Gas or Air as a Circulating Medium Instead of Mud." In addition, J. E. Keller, of Dow, Lohnes, and Albertson, will speak on "Communication Relations with the Federal Communications Commission"; D. C. Palm, Natural Gas Pipeline Co., on "Pipeline Breaks"; and Prof. Eric Lindahl, mechanical engineering department of the University of Wyoming, on "Pulsation Exploration as it Affects Gas Measurement."

First-day luncheon conferences will be devoted to communications, with W. T. Bulla, Natural Gas Pipeline, presiding. Mobile radio for transmission and distribution systems, telephone service, microwave systems, and applications for radio service will be topics for discussion.

John Goodman will preside at the second general session.

N. C. Comfort will head compressor station conference.

Highlights of the compressor station luncheon, which will be presided over by Rex V. Campbell, Michigan Wisconsin Pipe Line, will be a session devoted to water disposal. Pulsation and gas turbines will be covered too.

Pat H. Miller, Texas Eastern, will preside over the large volume gas measurement conference, which will feature reports by Howard S. Bean, National Bureau of Standards; Prof. Samuel Beitler, Ohio State University; H. B. Mc-

C. L. Perkins will discuss well drilling with gas or air.

H. W. Joiner will join in the water disposal session.

Nichols, Columbia Gas; and F. C. Witting, Peoples Gas Light.

W. B. Haas, Northern Natural, will preside at the pipeline meeting, where personnel and equipment requirements for pipeline operation and maintenance, maintenance of pipeline right-of-way, internal cleaning and testing of gas transmission lines, and welding practices on operative high pressure transmission lines will be discussed.

Committee reports on deliverability problems, statistics, storage lease forms, and verifying storage inventory will be presented during the underground storage session, under the chairmanship of John V. Goodman, Equitable Gas Co.

Mr. Goodman will also preside at the Friday morning general session, where one of the highlights will be a review of hydraulic fracturing in the petroleum industry, presented by George C. Howard of Stanolind Oil & Gas. Additional talks will be presented on progress in compressor station operations, interconnected pipeline systems, gas storage in depleted oil reservoirs, and chemicals from gas, petroleum, or coal.

Grove Lawrence will preside at the first general session.

Luncheon conferences will include compressor stations, with N. C. Comfort, Hope Natural, presiding. Preventive maintenance of gas systems, gas cleaners, and dehydration are subjects to be covered. These will be followed by a discussion on the preparation of a manual outlining the functions of a dispatcher.

At the pipeline construction session (A. J. Shoup, Texas Eastern, presiding), discussions will cover right-of-way and damages as related to pipeline construction, proof-testing pipelines after installation, construction equipment limitations, and inspection during construction. T. W. Johnson, Union Producing Co., will preside at the natural gas conference, where drilling and hydraulic fracturing will be discussed.

Edward Henderson will join in pulsation discussion.

Rex Campbell will discuss compressor station progress.

Gas industry movies will be shown on both days from 4 to 6 p.m.

Two of the largest users of aircraft in their operations are Northern Natural Gas Co., three of whose fleet of five planes are shown at left, and Transcontinental Gas Pipe Line Corp., who has the Ventura, shown at right, along with six other planes. That a dozen major companies are now making widespread use of planes is shown in the GAS survey in this article.

Aircraft popularity grows for many uses—from aerial patrol to executive transport

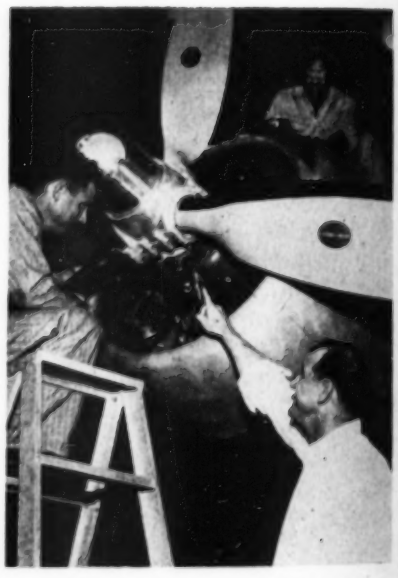
By WILLIAM W. CLARK

NATURAL gas transmission companies, whose operations may be scattered over 2000 miles or more of terrain and whose most vital installations are likely centered in such out-of-the-way places as Mankato, Minn., and Opelousas, La., are finding the airplane to be virtually a necessity in their day-to-day conduct of business.

In fact, a dozen of the top companies could pool their present fleets and muster up a respectable force of nearly half a hundred single- and twin-engine craft.

The era of aerial pipeline patrol has given way to the age of executive transport by company-owned and leased planes. True, patrol of pipeline from the air, which had its biggest impetus shortly after the end of the war, is still a major application of aircraft; but their usefulness has been extended far beyond that point, particularly in the last three or four years. A vital part is needed in a remote compressor station; it is flown there and the station is quickly restored to top operating efficiency. A blowout occurs; personnel are flown to the trouble spot and gas flow is quickly restored. A construction crew finds it has unforeseen needs for materiel and men; they are dispatched rapidly.

But fully as important as these applications in these days of burgeoning expansion of the natural gas business are the "executive" uses of company-owned planes. A hearing in Washington requires the presence of an expert from the home office. From the mid-continent area, with no airline schedules to have to meet, the expert can be off the ground on short notice and in Washington the same day. Transfers, stops, and layovers are eliminated. Or a superintendent wants to survey a situation in the field; small planes that can land on the tiniest of airfields will take him directly to the locale. A gas supply representative wants to investigate a



Several major companies have their own servicing organizations. Here Transco's chief pilot, Bob Harlow (right) and co-pilot-mechanic, Al Taska, check the prop on one of the Ventura motors before take-off. James A. Jones, top right, finishes a polishing job on the big plane.

GAS survey

THESE COMPANIES OWN THEIR OWN PLANES

Company	First Purchased	How Many	Investment	Types	Used for	Air Time Per Month	How Many Pilots	How Many Service People
El Paso Natural Gas Co.	1947	6	—	1 Lodestar, 1 Twin Beech, 2 Bonanzas, 2 Cessnas	General transportation	350 hrs	8	3
Gulf Interstate Gas	1953	2	$100,000	Twin Beech	Executive travel	80 hrs	2	1
Kansas Nebraska Natural Gas Co.	1945	4	110,000	1 Twin Beech, 1 Cessna, 2 Bonanzas	Executive, 90% Patrol, 10%	80 to 100 hrs	3 (1 part time)	0
Anonymous	1949	4	200,000	Douglas, Beechcraft, 2 Pipers	Patrol, 50% Personnel and parts, 50%	250 hrs	6	2
Natural Gas Pipe Line Co. of America	1950	2	85,000	1 Twin Beech, 1 Cessna 170	Beech, executive Cessna, 80% patrol, 20% field trans.	110 hrs	3	0
Northern Natural Gas Co.	1948	5	—	2 Cessnas, 1 Bonanza, 1 Twin Beech 1 Lockheed Ventura	Executive, patrol, tool and personnel	300 hrs	6	1
Southern Natural Gas Co.	1948	5	155,000	3 Cessnas 170, 1 Beechcraft, 1 Cessna seaplane	Patrol, 70% Personnel, 30%	—	6	0
Texas Gas Transmission Corp.	1949	3	78,000	2 Bonanzas, 1 twin engine Beechcraft, 1 Cub Cruiser, 1 Aeronica	Planes owned for executive; leased for patrol	owned: 85 hrs leased: 160 hrs	0	0
Texas Illinois Natural Gas Pipe Line Co.	1950	3	178,000	1 DC-3 Executive, 1 Cessna 170, 1 Sparton-Aero Commander	DC-3, Executive Cessna, patrol and field trans. Aero, 50-50, patrol and trans.	150 hrs	4	1
Transcontinental Gas Pipe Line Corp.	1948	6	300,000	3 Cessnas, 1 Ventura, 1 Twin Beech, 1 Bonanza	⅓, personnel ⅔, patrol	—	8	5
Westcoast Transmission Co. Ltd.	1948	4	—	2 Cessnas, 1 Lockheed 12A, 1 Lodestar	Executive and field trans.	50 hrs	4	2

promising new area; he can be there, on the ground floor, so to speak, in jig time.

These and many other uses have brought the airplane to a position of importance in the transmission company's scheme of things. A company with a fleet of half a dozen craft may log as many as 300 hours per month in the air, and employ five or six full-time pilots. Several companies have their own maintenance programs. Investment in the aircraft themselves may total upwards of $200,000.

A company such as Westcoast Transmission Ltd., which has been carrying on a several-years' campaign to win the right to serve Alberta gas in the Northwest U. S. market, is an outstanding example of an executive plane user. The company, which is a subsidiary of Pacific Petroleums Ltd., Calgary, must be in frequent personal communication with Washington, New York, Seattle, and even California. President Frank MacMahon, dubbed the "flying gasman," travels as much as 200,000 miles per year in a desk-equipped plane. Currently the company is logging upwards of 50 hours per month making twice-weekly trips to Fort St. John, B. C., which is the center of its operations in the Peace River area.

The company has four planes, including a Lockheed 12A, a Lockheed Lodestar, and two Cessnas.

Another company which is not in operation as yet on its gas pipeline yet already owns its own plane is Gulf Interstate, currently constructing an 860-mile line from Rayne, La., to supply Columbia Gas System near the Kentuck-West Virginia line. Gulf Interstate's two planes, both twin Beeches, are in the air an average of 80 hours per month, operating out of Houston. To date they have been used solely for executive travel.

El Paso Natural, one of the biggest users of aircraft, reserves its planes for general transportation only. Its rapid growth involves numerous trips to Washington and to newer producing areas, as well as throughout its sprawling system. Eight full-time pilots are employed, as well as three servicemen. Its six planes include a Lodestar, a twin executive Beech, two Beechcraft Bonanzas, and a 170 and a 180 Cessna. El Paso is a veteran user among pipeline companies, having purchased its first plane in 1947. Up to 350 hours of flight time are logged each month.

Natural Gas Pipeline Co. of America and its affiliate, Texas Illinois Natural Gas Pipeline Co., provide two illustrations of diversified aerial operations. Between them they own five planes, of which Texas Illinois owns three. One,

a DC-3 executive model, is used exclusively for transporting executives and top-level personnel. A Cessna 170 logs 80% of its flight time in patrol work, 20% in field transportation. A Spartan Aero-Commander's flight time is split about 50-50 between transport work and patrol.

Natural Gas Pipeline has a Twin Beech executive model on full-time duty carrying top-flight men, and a Cessna 170 which spends 80% of its time on patrol and 20% in field transportation.

Texas Illinois has four full-time pilots and a mechanic; Natural Gas Pipeline has three full-time pilots.

Exact operating costs are difficult to obtain, but it's an established fact that pipelining by air is not a cheap mode of operation. One company figures its Beechcraft costs $107 per hour. A Cessna 170 costs about $22 per hour. On a per-mile basis, a DC-3 costs one company $1 per mile. This same company has a Beechcraft D18-S, which runs 60 cents per mile. Its smallest plane, a Piper, runs for about 16 cents. At full load, of course, even the larger planes will pay out at such rates.

Time-saving is the important factor, and it is hard to measure. Labor saving is an important advantage on patrol work, and one transmission company is known to have replaced upwards of 75 line walkers and other patrol personnel with a single plane.

The use of aircraft extends considerably beyond the limits of those companies that own their own ships. Several independent contractors have built profitable businesses out of flying patrol for one or more pipeline companies. Some companies lease planes, and one company, Texas Gas Transmission Corp., does both.

The relatively inaccessible location of Texas Gas' headquarters, at Owensboro, Ky., has influenced the manner in which the company's air fleet has been organized. Texas Gas owns two Beechcraft Bonanzas and one twin-engine Beech, all three of which are hangared at Owensboro. One of their principal uses is for connecting flights with commercial airlines, although they are used for other executive travel.

The company has no regular pilots or service personnel. Two planes are leased for aerial patrol, a single engine Cub cruiser and an Aeronca. Between them, they log about 160 hours per month in the air.

A dozen other major transmission companies depend solely upon lease or hire arrangements. Michigan Gas Storage Co. uses a single Cub Pacer for about 11 hours per month on pipeline patrol. Algonquin Gas Transmission Co. leases a single engine, two-place ship for aerial patrol on a 45-hour-per-month basis. The Pittsburgh Group of the Columbia Gas System uses a Super Piper Cub for 50 hours on general

COMPANIES THAT LEASE OR HIRE PLANES

Company	How Many	Type	Air Time Per Month	Uses
Algonquin Gas Transmission	1	2-passenger monoplane	—	Patrol
Central Hudson Gas & Electric Co.	1	Piper Clipper	1 hr	Patrol
Colorado Interstate Gas Co.	2	Cessna 170-195	16,000 mi.	Patrol, 90% Personnel, 10%
Consumers Power Co.	Varies	Ryan Navion	—	Executive travel
Iowa-Illinois Gas & Electric	Varies	Tri Pacer and Super Cub	1 hr	Patrol
Michigan Consolidated Gas Co.	1	Beechcraft or Piper Cub	15 hrs	Patrol
Michigan Gas Storage Co.	1	Cub Pacer	11 hrs	Patrol
New York State Natural Gas	1	Stinson Voyager	25 hrs	Patrol
Niagara Mohawk Power Corp.	2	Stinson-Taylor	137 hrs	Patrol
Ohio Fuel Gas Co.	1	Cessna	25 hrs	Patrol
Pittsburgh Group, Columbia Gas	1	Super Piper Cub	50 hrs	Pipeline survey

Scheduling and dispatching of Northern's flights is the chief duty of W. T. O'Hanlon, staff assistant, aerial operations.

Transco's well-organized and staffed aviation department includes Twin Beach Pilot W. W. Lowery Jr. (left) and co-pilot-mechanic W. E. Thomas Jr., who take their plane into fields and airports passed up by the large commercial lines.

Considerable record keeping is involved in plane operation by Transco. Here Jim Green (left) and George Cendrick, superintendent of maintenance and operation, bring the logs and maintenance records up to date.

pipeline survey—looking for leaks, washouts, building or coal stripping on the right-of-way.

The line walker is not yet extinct, even among companies that have adopted aerial survey methods. Central Hudson Gas & Electric Co., for example, hires a Piper Clipper for a single one-hour trip per month to survey a 40-mile stretch of 10-in. transmission main. This supplements the regular ground patrol, where a power wagon is used along with regular foot patrol. Niagara Mohawk Power Co. uses two Stinson-Taylors for a twice monthly patrol of 137 miles of transmission main. Yet periodic foot patrol is also used, although at some later date the frequency of line walking may be reduced. The company's official appraisal: Aerial patrol affords "extra protection at slight added cost."

Under contract agreements, and in comparison with foot patrol, costs of aerial service are more easily obtained than is the case with companies owning their own ships and using them extensively for executive travel. The time element is easily measurable. Iowa Illinois Gas & Electric, which occasionally hires a Tri-Pacer PA-22 and a Super Cub PA-18 for an average of less than one hour a month, figures that eight hours of plane inspection per month replaces 100 man hours of ground inspection. New York State Natural Gas Co. carries the comparison a step farther—to actual per-mile costs. New York State uses one Stinson Voyager for 25 hours per month. Cost per mile is 24 cents, a saving of $1.56 per mile over line walking methods.

Wide variance is noted in per-mile costs for contract work. Flying time and flight conditions would not appear to be decisive factors in determining these costs. One company, which hires planes for 11 hours per month, spends 18½ to 20 cents per mile. Another with 45 hours figures its cost at 25 cents per mile. A 50-hour user has an average cost of $20 per hour. Iowa Illinois figures 17 cents per mile or $19.50 per hour for one plane, $15 per hour for the other. Yet another company with only 15 hours of flying time per month pays only 10 cents per mile.

Costs aside, however, more and more companies seem to feel that aircraft are almost indispensible for long-range pipeline patrol work. Colorado Interstate Gas Co., which contracts for the use of two Cessnas three days per week, averaging 16,000 miles per month, says:

"Patrolling lines by air is the only really successful way in which to carry out such a task. It gives quick indications of small leaks and major ones, and also gives the company an opportunity to constantly watch right-of-way areas where contour farming or highway construction might cause damage to lines."

The helicopter may be coming into its own in airplane operations. In addition to its use by Gulf Interstate Gas Co. in surveying for right-of-way, Southern Counties Gas Co. used these aircraft as explained in the box below.

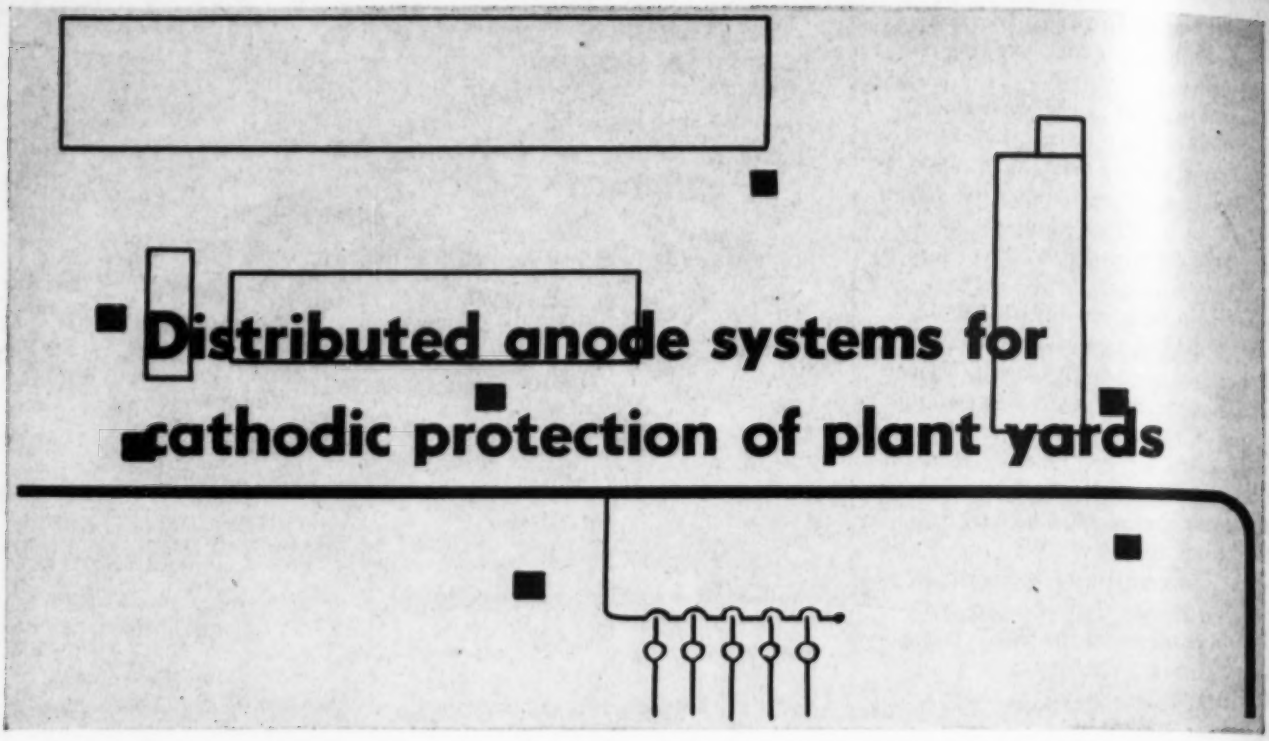
In a few years, the airplane may be old stuff in pipelining work. The helicopter, workhorse of the Korean war, may yet become the pet of air-minded pipeliners.

The job a big whirlybird did for Gulf Interstate in surveying half-submerged rights-of-way in the Louisiana marshland was well publicized (see *GAS*, October 1953, pages 121 and 130). In the far west, they're adopting them on a limited basis for regular operations.

Pacific Gas & Electric Co. has used them, along with small planes, for electric line patrol and survey of rights-of-way. But Southern Counties Gas Co. has gone considerably beyond this. James A. Millen, manager of transmission and supply, writes:

"We have a contract with a helicopter company, whereby we are able to call on them for use of their equipment, particularly in the case of an emergency to get men or equipment to an isolated area, or to survey any damage that might occur to our facilities, particularly as a result of a storm, earthquake, etc. Since entering into this contract, however, we have not had occasion to call upon them for service. The contract was entered into because of the very satisfactory experience we had with a similar company during an earlier emergency. We cannot give you a cost-per-mile for this service, as our contract is strictly on a time basis and covers standby time as well as actual flying time. However, we feel it to be very reasonable and it certainly is a great time-saver and could be the only method of reaching an isolated spot in the case of a catastrophe."

Pilot Robert McQuilkin can have Transgas' Bonanza in the air within minutes after receiving call.



Distributed anode systems for cathodic protection of plant yards

By B. J. WHITLEY JR. • Tennessee Gas Transmission Co., Houston

The discovery that concentrated cathodic protection ground beds along the edge of Tennessee Gas Co.'s plant yards did not give adequate protection to the underground structures and piping in the center of the plants resulted in the distribution of anodes at locations determined by the yard piping and local current requirements.

The design and installation of Tennessee's protective bed—adjusting the individual anode current output, intersystem bonding, rectifier maintenance, and periodic piping-to-soil voltage survey—can be adapted to any specific yard.

The problem

Conventional concentrated ground beds had been installed at the compressor stations, some draining up to 100 amps, but corrosion continued to be observed in the plant yards. Detail pipe-to-soil voltage surveys were conducted with an interrupter operating the rectifier. By this technique, it was observed that current was not reaching into the yard past the outer extremity of the yard piping where the pipe-to-soil voltage was relatively high, particularly so on the side with the ground bed as would be expected.

The problem then was to obtain a better distribution of the current throughout the plant area, and by placing anodes where this current was needed the distribution was obtained. That is the reasoning that is followed now on the cathodic protection of the plant yards.

Initial steps

The very first step toward protecting a station is to obtain a correct and complete general piping layout of the yard. This should locate all structures, buildings, residences, cooling towers, water tanks, storage tanks, air storage tanks, high pressure gas lines, fuel lines, fresh water lines, fire water lines, air lines, oil lines, products lines, drain lines, storm sewer lines, disposal beds, radio towers and their anchors, fences, sidewalks, plant roads, etc. These have all been listed to stress the fact that every square inch of the yard will be considered in laying out the anodes and cables, and to enable the engineer to do it properly the first time. Even with this information, the piping and the cable and anode layout will have to be checked on the ground itself.

This general piping layout should include information about the structures and lines, such as, whether or not they are doped, whether black steel or galvanized, whether they should be electrically connected to the main system, etc. The routes of buried power and lighting cables will have to be known. There is no such thing as too much information.

If concentrated beds are in service at the plants, a detail pipe-to-soil voltage

Mr. Whitley, an honor graduate of Southern Methodist University, is a corrosion engineer with Tennessee Gas Transmission Co., working in the Texas area. He has been with the company for four years, and before his Texas assignment had worked on its system in Ohio, Pennsylvania, and New York.

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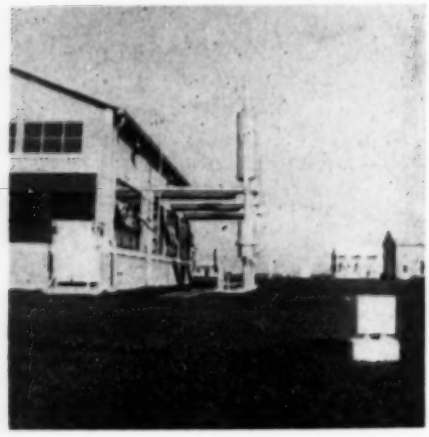
survey should be made using the compiled information on the general piping layout. With this, the designer of the distributed bed will concentrate only on the areas that are not being protected by the concentrated beds.*

The number of anodes in any area will depend on the current requirements of the area, and the soil resistivity. If considerable bare or poorly coated surface is present, the current will not give the desired spread from a few anodes. To get the spread, more anodes will have to be distributed within the same area.

It has been found that more current is needed along the sides of the buildings and structures because the piping is electrically connected to bare structural steel that goes underground, and to catwalks, to bare steel drain lines, etc. Therefore, from three to



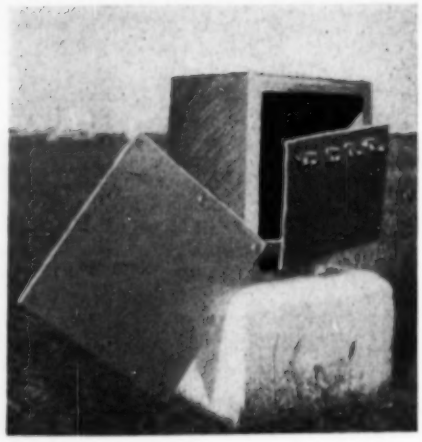
A junction box in the auxiliary building area. Note rectifier installation.

seven anodes may be needed along each side of compressor buildings up to 200 ft long, with a current output of from 2 to 5 amps each.

Designing the anode locations

By using the information on the layout print, graphite anodes can be spotted in the center of the "boxes" formed by the underground piping and between the buildings to distribute the anodes throughout the yard and yet keep them as far away as possible from any line. Sometimes this can only be a few feet, but the current can be limited on these close anodes. By using more closely spaced anodes, the individual anode outputs will be limited, and they can be limited further by resistors.

Another place where extra current



Open junction box showing terminal board.

was needed was along the fan-radiator type coolers and starting racks. The reason found for the high current requirements here is the grounding system used. Several feet of bare copper cable, as large as 1½ in. in diameter, is used to ground the motors and starting racks. The cables connect to bare copper ground rods and then to the gas and water piping also. The cathodic protection current is lost to the relatively large surface of this bare copper.

Buried hot water surge tanks and hot water lines, if not doped with a heat-resistant dope, will require additional current. In some cases, steel rails as anodes have been buried parallel to the underground tanks and large headers in order to obtain the effective distribution of the current.

Designing the cable layout

When the anode locations have been spotted, the next consideration is the connecting cables. The size of the cables will, of course, depend on the current to be carried, which in turn depends on the number of anodes to be supplied

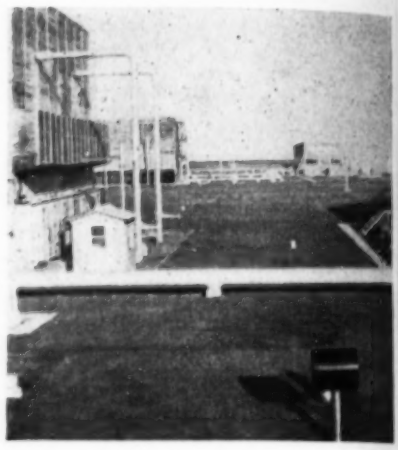
Installation of two junction boxes along compressor building.

by each run, the length of the run, and the possibility that future additional anodes will be needed. Some runs have been for several hundred feet.

The cables should be installed parallel to the grid of the plant yard, the routes should be marked on a general piping plan, and this plan entered in the files of the plant for easy reference.

Of course, insulated wire should be used for these cables, with a quality covering capable of withstanding direct burial.

It is recommended that junction boxes be used at convenient intervals, usually at each anode. However, for closely spaced anodes, one junction box could serve several, but each anode lead should be brought separately into the box. The positive lead from the rectifier should terminate in each box and be connected to a bus there. The anodes that are served through that box



The area between compressor building and cooling tower is protected by three junction boxes.

and the positive lead going on to other boxes will connect to this bus also. This provides a check point to determine each anode output and an easy way to find broken lead wires. The junction boxes will also eliminate underground splices.

A convenient size box is 8 in. by 8 in. by 6 in., with gasket cover, that can be mounted on four joints of conduits, measuring about 1¼ in. The conduit can be in a small concrete pier and the conductors passed through the conduit into the box to the bus on a terminal board. A good installation is made if the pier is half buried and the box mounted about 1 in. above it. That way the box will be about 6 to 8 in. above the ground.

The negative return can be connected to several lines at several places

*Further on the discussion will include what is meant by a detail survey.

in the yard to insure uniform current drainage.

At the rectifier, a larger terminal box will facilitate using a convenient bus to connect the loads of each ground bed section to the positive output of the rectifier and the negative leads to the negative output.

Pipe-to-soil voltage survey

When the installation is placed in service, the current output of each anode, read at the small junction boxes, and of each ground bed section, read at the rectifier junction box, should be recorded so that these currents can be checked in the future when conditions are similar.

The amount of protection received from each known anode output can be determined most economically by a pipe-to-soil voltage survey. In congested pipe areas, voltage readings should be taken with the reference electrode positions only a few feet apart, and, of course, over each line. In this type of area, and along the edge of buildings and structures, a spacing of 3 ft will show considerable differences in potential, especially near bare or poorly coated lines.

It is important to know if the voltage observed is a result of the applied current, a result of couples by galvanized pipe, or just a high voltage anodic area. The voltage from the applied current can be found by interrupting the current and noting the "on" and "off" readings. This will not tell the full influence of the current, but it will tell where the protection is.

A convenient record of these pipe-to-soil voltages can be made on a print of the general piping plan. The readings can be noted right where they were taken and color-coded to show the difference between the "on" and "off" voltages and the voltages on the different systems.

Intersystem bonding

When making the voltage readings, care should be taken to make the negative contact to the same system electrically as the one that the plug is over. For instance, it is easy to have the negative contact on the general piping system and the plug over a bare steel drain line that is not electrically tied into the rest of the system. For this reason, a separate contact should be made to each different piping system to check for electrical continuity, even though most of the piping will be already connected through the compressors, etc. All piping that is to receive protection will have to be bonded, of course. If there is an isolated system that is extensive, it should be bonded in several places.

Systems like bare steel drain lines that are close to the ground bed can be damaged. These lines will pick up current near the anodes and discharge it near the negative drain point or through the earth to lines that connect with the negative drain point.

Foreign pipelines should be insulated from the yard piping and, if necessary, resistance bonds can be installed.

Adjusting current output

The pipe-to-soil voltage survey will show the effects of the current in each area. If the voltages are all excessive in any area, the current can be limited by resistors installed in the small junction boxes, connected in the anode leads.

But the usual situation will be that more current is needed. Additional anodes can be installed in those areas and either connected in the existing junction boxes or in new boxes. The interrupted current readings will give some indication of how much additional current is needed.

At times, the area of the cathode in a location is so large that more current is drawn from an anode than it is designed to handle if it is to have the desired life. A convenient solution is to install another anode near the first so that the current that is required will be divided between the two.

Maintenance

The d.c. output of the rectifier should be read and the reading recorded about once a week. A good history of the ground bed performance can be seen from this record. In some cases, the anodes may have to be watered in drought areas.

Conclusions

The task of distributing the current properly through the plant yard can be accomplished by distributing the anodes where the current is needed, and the pipe-to-soil voltages can be made sufficient yet not excessive over the entire yard.

There are endless possibilities and variations to this effective and neat type of system for plants; and the principle can be adapted to any yard regardless of size or congestion.

This article is adapted from a talk presented at the NACE south central regional meeting held last October in Tulsa.

Safety features incorporated in redesigned truck

Charles Pfister, Columbus district garage superintendent of Ohio Fuel Gas Co. has redesigned a one-ton pickup truck, and with the help of Oscar Myers, auto mechanic, mounted a Lincoln Arc electric welding unit on the bed.

Controls were removed from the front of the welding unit and mounted on the curb side of the truck so the operator can reach them from a standing position on the ground. The new design also affords the operator a clearer view of all the controls.

In addition, acetylene tanks for welding operations were placed on the bed of the truck in such a manner that they are readily accessible and easily removable. All welding gauges for acetylene operations are carried in a special compartment built for that purpose.

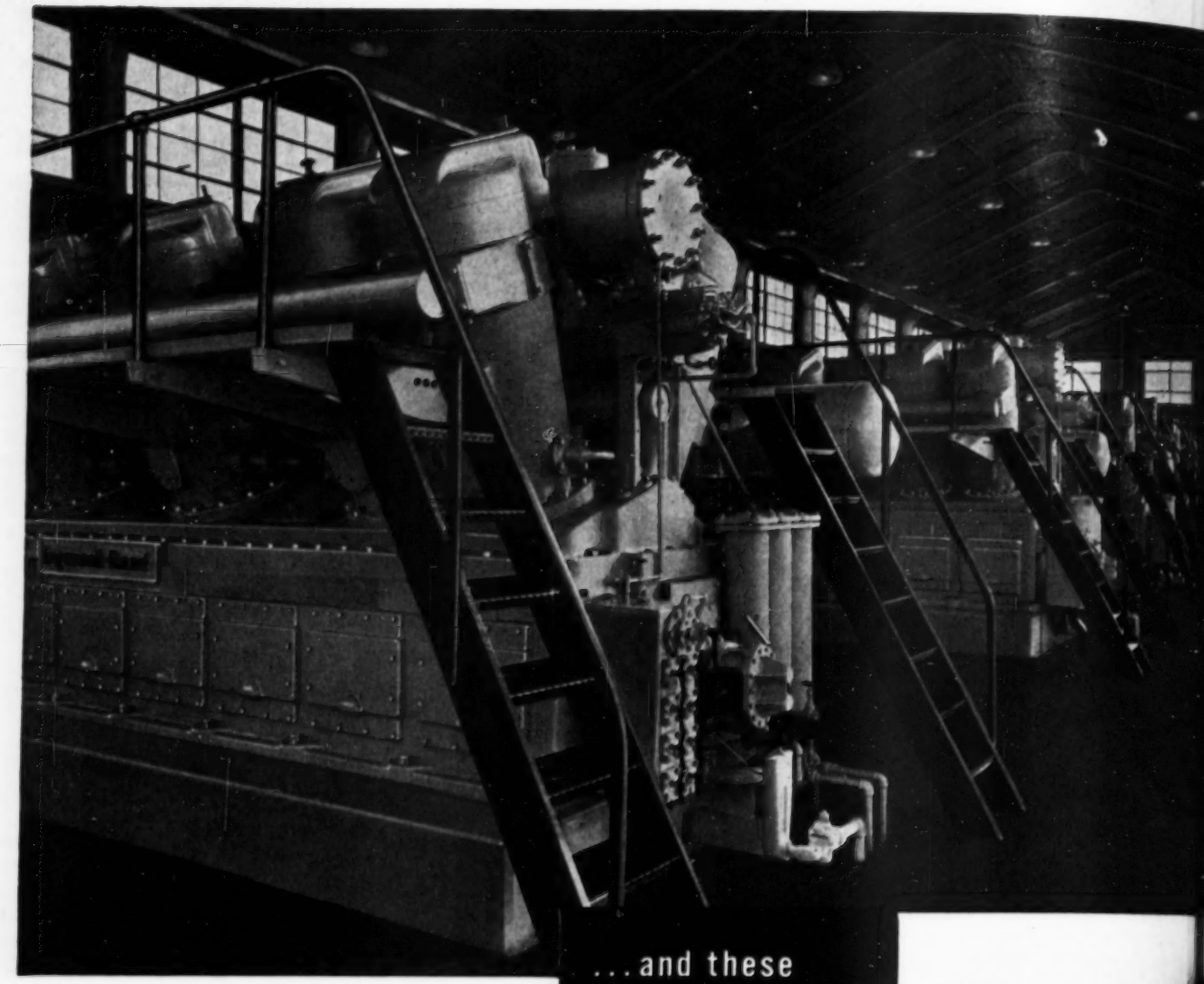
Before the redesigning of the truck, welding operators were in danger of slipping, falling, or straining themselves in unnatural positions assumed when crawling into the truck to change the controls.

Not only does the new welding truck unit eliminate existing hazards, it speeds welding operations.

This is the third truck Mr. Pfister has designed, and Mr. Myers has built, for welding machine operations. The designs have been so proficient that other operating groups of the Columbia Gas System have borrowed the plans.

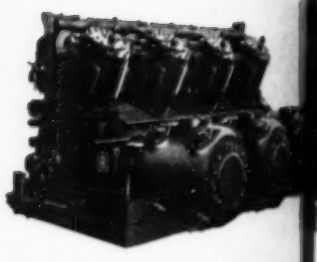
Clearer view of controls is possible with side-mounting.

TWELVE I-R KVG GAS

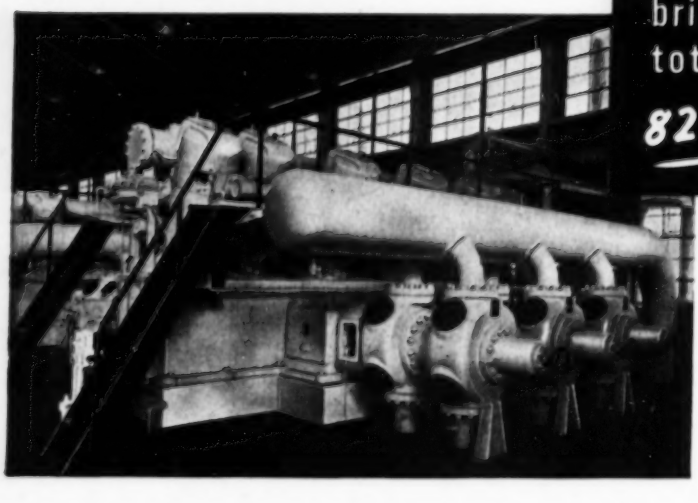


Six Ingersoll-Rand KVG gas-engine-driven compressors installed at United Gas Pipe Line Company's new Needville, Texas, gas booster station. These 1320-hp units boost gas pressure to 900 psig on a new 30-inch line.

...and these OTHER I-R compressors and gas engines bring United's total to *82 MACHINES!*



35 XVG's



Another view of the six KVG compressors at United Gas Pipe Line Company's Needville Station showing the compressor cylinders. This installation is duplicated at the Goodrich station.

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GAS ENGINE-DRIVEN COMPRESSORS

add 15,840 hp to rapidly expanding natural gas system of

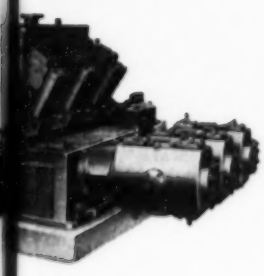
United Gas Pipe Line Company

It is a privilege to serve those who serve the Nation. Hence Ingersoll-Rand takes justifiable pride in the recent installation of twelve KVG gas-engine-driven compressors by the largest handler of natural gas in the world. These 1320-hp units, installed in booster stations at Needville & Goodrich, compress natural gas to 900 psig on a new 30-inch line – part of United's continuing program of system expansion.

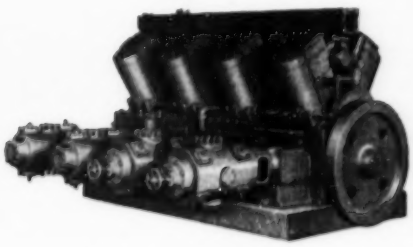
Ingersoll-Rand equipment is well known to operators throughout the entire United Gas Pipe Line system. For United has been using I-R compressors and engines for the past sixteen years.

The first of the famous XVG compressors were installed in 1937. Subsequent installations brought United's total to thirty-five of these XVG units – the original V-angle design pioneered by Ingersoll-Rand. Also included on the United Gas Pipe Line system are twenty-three of the newly-acclaimed JVG and SVG compressors, superseding the original XVG design – fourteen JVG units in 110, 165 and 220 hp sizes, and nine SVG units in 330 and 440 sizes. In addition, twelve 408-hp PVG gas engines have been installed for serving their pipe line stations.

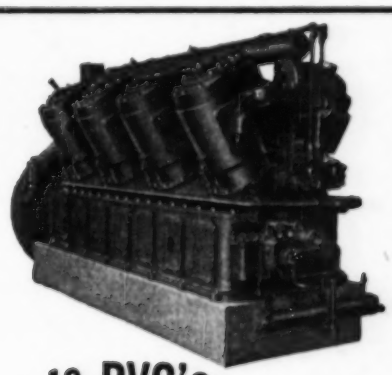
All of these compressors and gas engines are now in operation, giving the continuous dependable service for which I-R equipment has become traditional throughout the gas industry. Your nearest Ingersoll-Rand representative will be glad to give you complete information on I-R V Four-Cycle gas-engine-driven compressors in any type or capacity.



4 JVG's



9 SVG's



12 PVG's

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Inspecting pipeline welds by radioactive isotopes

By **DR. P. J. STEWART** • Isotope Products Ltd., Oakville, Ontario

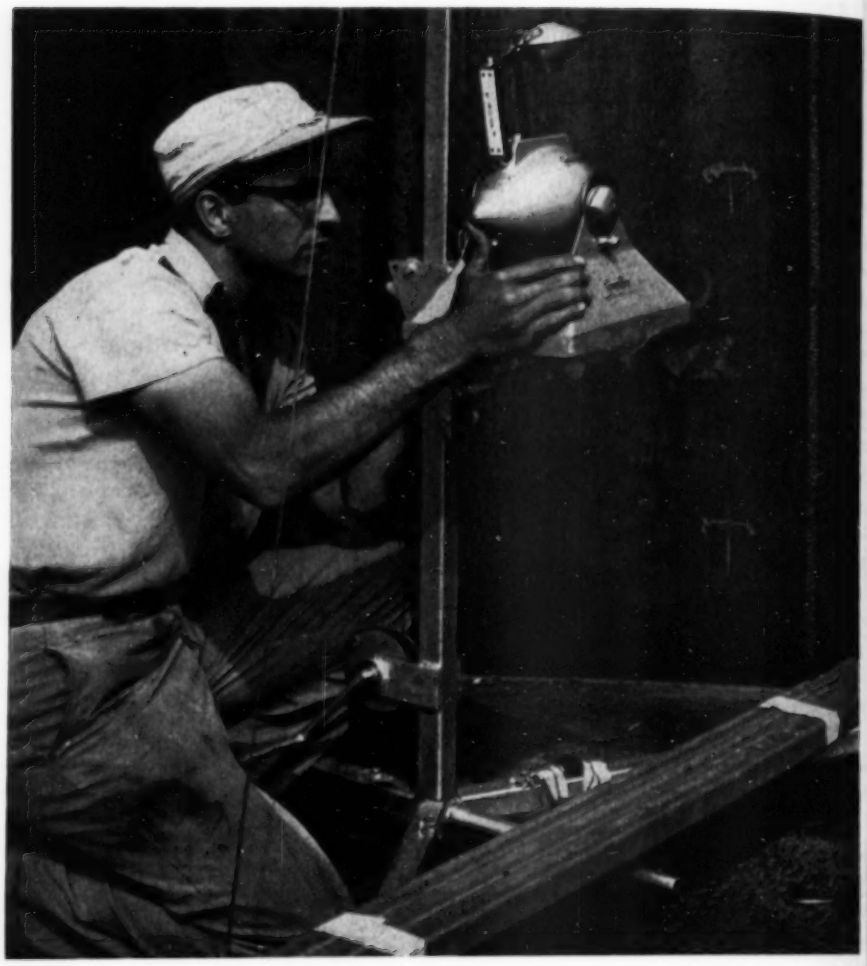
FIVE Canadian pipelines have recently been inspected by a new "atomic" method. And this same method has also served to inspect oil storage tanks, liquid and gas spheres, high pressure piping and refinery units, all in new record times.

Isotope Products Ltd., the company responsible for these developments, uses one of the artificial radioactive materials that are now prepared in nuclear reactors on this continent. The U. S. reactors at Oak Ridge and Brookhaven and the Canadian Chalk river pile are the major producers of these radioactive materials. They can all be regarded as large "furnaces"; metals and chemical compounds can be put into these furnaces and they come out "hot," or radioactive. They remain hot for quite a long time, too, many years in some cases.

Invisible light rays

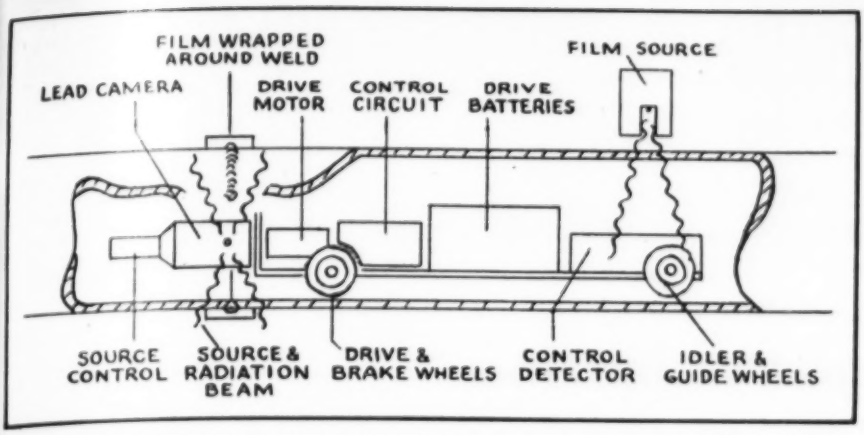
These radioactive materials all emit rays that can be thought of as invisible light rays. Unlike ordinary light, however, these rays can "see" through materials. The rays are of various types, some stopped by a few thicknesses of paper, some able to penetrate a foot or more of steel. In the inspection of welds we are mostly concerned with rays that can penetrate steel up to 2 in. thick. Isotope Products has developed the use of radioactive material (an "isotope") that emits rays admirably suited to this thickness range. It is a form of radioactive iridium (iridium 192), prepared by putting the rare platinum-type metal iridium into one of the nuclear furnaces.

The major advantage of iridium lies in its portability. Unlike radium or radioactive cobalt, it requires comparatively little lead to stop its rays. This means again that larger amounts of iridium can be handled in safety. Radioactivity is normally measured in terms of "curies," a word coined in honor of the discoverer of radium. Until recently a curie was a large amount of radioactivity—a curie of radium for instance costs many thousand dollars and a curie of cobalt needs 100 lb of lead to protect it. But with iridium, 30 to 50 curies are normal for pipeline inspection and up to 200 curies have been used for radiography of large tanks.



Exposure camera used for weld inspection in storage tanks.

Handling such large radioactive sources means the use of carefully designed equipment. This equipment, although in most cases specially engineered for the job, is not in any case prohibitively heavy. In fact, almost all the exposure "cameras" used can be carried by one man. One of these cameras, called the external pipe camera, has been in use on the five Canadian lines previously mentioned. Weighing only 30 lb, it operates by bringing the isotope close to the outside of the weld. The camera is clamped onto the pipe and a film, with lead-intensifying screens, is fastened onto the pipe so as to cover the opposite side of the weld. The camera is opened and closed by the manipulation of a 4-ft cable, which means that the operator is at a safe dis-



Main layout of newly developed camera for use on large-sized lines.

tance from the machine when the radioactive material is exposed.

One of the two photographs shows the operator opening the camera, the other the camera in use on an 8-in. oil line. The line is the 180-mile Sun pipeline, built last summer and now carrying products from Sarnia to Toronto. On this line an average of 30 welds a day were inspected during the four months that the line was under construction. The camera could be positioned on the pipe by the one operator even in very rough country, through swamps, sloughs and river crossings where it was difficult to get any vehicle. The powerful iridium 192 sources used ensured that exposure times were small —a minute was standard, even with a slow, fine grain type of radiographic film.

The same type of camera was used last summer on two western Canadian lines, the Imperial Oil pipeline and the Northwestern Utilities line, which were inspected by Isotope Products Edmonton branch. It was also used on a section of the 30-in. interprovincial pipeline in eastern Canada. In all these cases the camera, clamped exactly on the weld line, could take up to 220° of the welded seam in a single exposure, with equal sensitivity and clarity along the whole length of the radiograph. For the "big inch" interprovincial line, the film used was in 70 mm strips 4 ft long held in specially designed plastic holders closed with zippers.

For "big inch" lines where 360° coverage of the weld is called for, Isotope Products engineers have developed another type of camera. This machine, a patented development like the external camera, is undergoing extensive tests before field use. It runs inside the pipe and is self-propelled and automatically operated. It is operated by a small control source of radioactive iridium outside the pipe, which stops and starts the machine, positioning it accurately in relation to the weld.

The main layout of this unit is shown in the sketch. The exposure camera, containing the isotope source, is at the front of the unit. When this source is exposed gamma radiation is emitted in a narrow beam through 360°. An electric drive motor, powered by two storage batteries and controlled by a radiation detection device, propels the internal camera unit through the pipeline.

The control detector, brain of this mechanized camera, is located at the rear of the unit. This control detector is sensitive to radiations from a low curie-strength source, which is carried by the operator outside the pipe.

The operator wraps film around the weld and places the control source at a fixed distance from the weld. Automatically the internal camera runs along inside the pipe and when the detector reaches a point immediately below the control source, a trigger mechanism cuts the motor and simultaneously applies a power brake. At this point the exposure source is directly aligned with the film wrapped around the pipe and an exposure is made. After a controlled exposure time the unit automatically resumes travel until it is stopped by the control source again.

Iridium has removed two of the greatest limitations on the use of gamma rays for radiography—their speed and clumsiness. Exposure times in iridium radiography are comparable with X-ray exposure times, and the small cameras are much easier to handle than a field X-ray machine, as well as needing no power supply. Iridium emits a low energy gamma ray, giving excellent sensitivity and contrast on the film.

Additional applications

Isotope Products has used iridium for other inspecting jobs in the oil and gas industry too. Welded seams on sphere-type holders up to 54 ft in diameter have been inspected in a one-shot technique—all the seams being covered by film and exposed simultaneously by a source at the center of the sphere. Oil storage tanks up to 150 ft in diameter have been similarly radiographed using very powerful iridium sources. Another interesting job in this field is the inspection of gas cylinders. A large batch of these cylinders used for storage of illuminating gas was recently inspected, using radioactive iridium sources projected into the cylinder via a locating tube. Corroded areas, scale, drawmarks deepened by pitting, and cracks around the base could all be observed in these cylinders. On pipelines again radioactive materials have been used extensively for tracing purposes, particularly in connection with the location of cleaner pigs. A radioactive "tail" on the pig, by means of which it can be followed above ground, was used on the Trans Mountain pipeline last summer.

External pipeline camera radiographing weld on 10-in. products line.

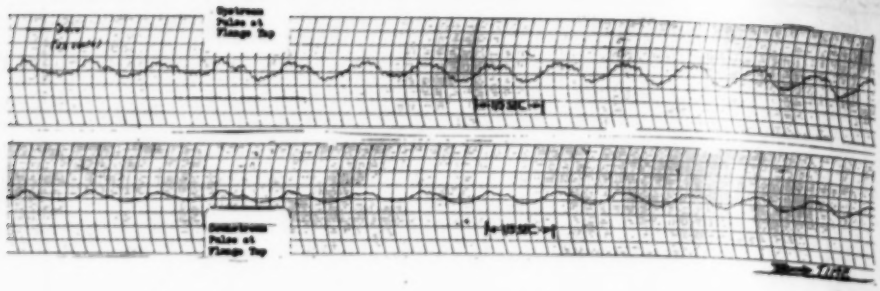


Fig. 1. Pressure waves at different points in orifice meter run (typical).

Effect of gas pulsation on orifice meter measurement

By **RAYMOND C. BAIRD** · Fluor Corp. Ltd., Los Angeles

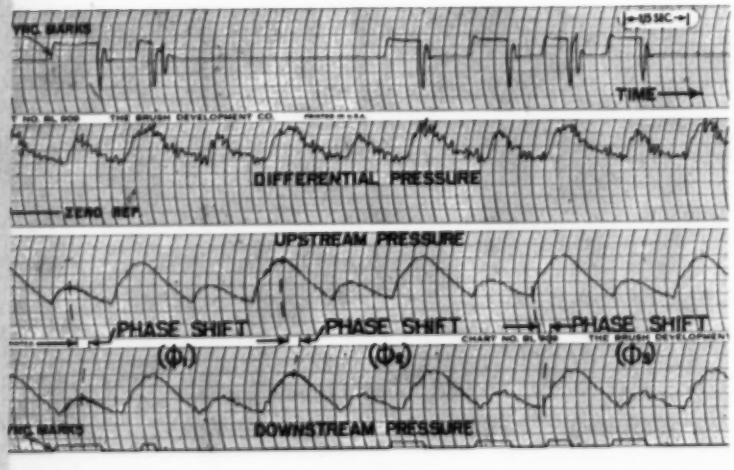
This article is a sequel to another on the same general subject in which was presented the concept of impedance mismatch caused by an orifice plate in a pipe, and the consequences arising therefrom.[1] It was pointed out that perhaps the major effects caused by impedance mismatch are a change of intensity of a pulsation wave propagating through the orifice and a change in phase of this wave at the orifice. These two effects are principally functions of orifice beta ratio, frequency of the pulsation wave, and, to a lesser extent, the flow rate. Pressure, temperature, gas density and viscosity are influencing parameters, but their effects will not be considered here.

This treatise is limited to a showing of the mathematical methods for calculating orifice metering error. In particular, it will be shown how the presence of pulsation causes an error in orifice differential pressure which in the case of a complex wave cannot be satisfactorily determined at the present time because of insufficient empirical data.

It is assumed, as in the first study[1] that the inferential type recording meter reads accurately the actual pressure differential occurring at the orifice taps. (The first study provides background for the procedures discussed here.)

• *Studies of the dynamic effects of pulsating gas flow in orifice metering indicate that the most effective ways to eliminate error caused by pulsation are to locate meter runs away from sources of pulsation and to reduce existing pulsation with dampeners or adequately sized surge chambers.*

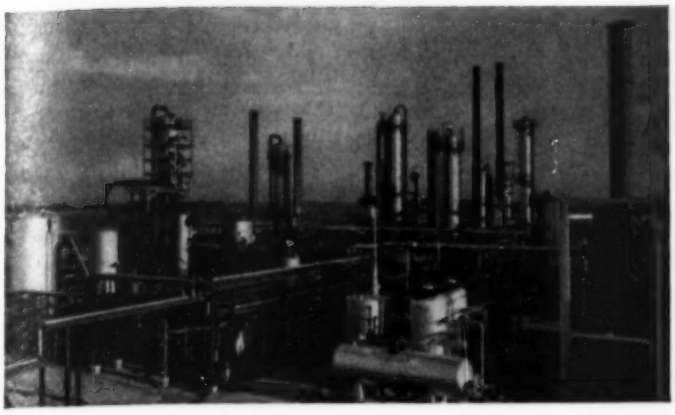
Fig. 2. Simultaneous traces of differential pressure, upstream pressure, and downstream pressure at an orifice plate showing it to be far too much on the conservative side.



Effect of intensity loss by orifice reflection

The intensity of a pulsation wave being transmitted through a pipe is the energy flow through unit cross-sectional area of the pipe per unit time. Whenever there occurs a sudden change of the cross-sectional area, a fraction of the incident pulsation intensity will be reflected. However, in the case of an orifice plate where the sudden reduction in area is almost immediately followed by a sudden expansion to the same area as before, Stewart[2] shows that neglecting viscosity and dissipation losses, a *sound* wave suffers no diminution of amplitude in passing through the orifice. This follows if the thickness of the orifice plate is very small as compared to the sound wave length. Thus, on the surface it would appear that reflection of pulsation in a meter run would have little effect in causing metering error. On the other hand, actual measurements show[1] that reductions in amplitudes of more than 50% can occur for components of a complex pulsation wave. This is graphically illustrated by *Fig. 1*, which shows actual pulsation waves occurring simultaneously upstream and downstream of the orifice in a meter run.

The apparent discrepancy with Stewart's results can easily be reconciled to the facts, however, when it is remembered that Stewart developed his expression for sound pressures which are infinitesimal as compared to pipeline pulsation wave pressures. In addition, he did not consider the effect of a static pressure drop caused by a superimposed gas flow through the orifice. Furthermore, he ignored viscosity and any frictional dissipation of sound energy. We know from actual measurements that a reduction in amplitude of a pulse wave will occur when it is passing through an orifice, the exact amount being a complicated function of pressure, temperature, viscosity, flow rate, incident pulse amplitude, and orifice β ratio.[3]



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$$(A/B) = f(P, T, \delta, Q, \Delta p, \beta) \quad (1)$$

where

A = amplitude of incident wave
B = amplitude of transmitted wave
δ = viscosity
Q = flow rate
Δp = pressure drop in absence of pulsation
β = ratio of orifice diameter to pipe diameter

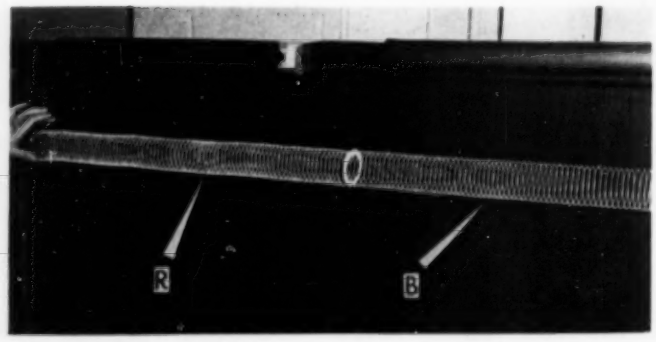

Fig. 3a. Mechanical meter run. Note that reflected wave (R) is further from "orifice" than transmitted wave (B), although their propagation velocities are equal.

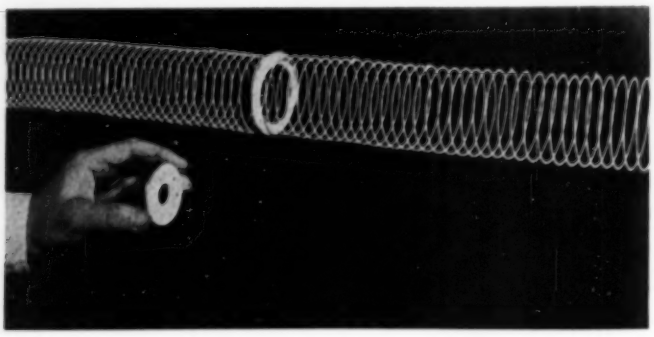

Fig. 3b. Mass insert for changing "β-ratio."

Phase shift

For an orifice Stewart[2] shows that for a sound wave (with zero net gas flow), a phase shift is introduced between the incident and transmitted waves. His expression for this shift when expressed in terms of beta ratio, β, and sound velocity, c, becomes

$$\varphi = \tan^{-1}\left[\left(\frac{\beta^4 + 1}{2\beta^2}\right)\tan\frac{\omega L}{c}\right] \quad (2)$$

where

$\omega = 2\pi f$, f = frequency
L = thickness of orifice

The application of this theoretical result to actual meter run measurements shows it to be far too much on the conservative side. *Fig. 2* illustrates the actual phase shift which was found to occur in a laboratory orifice meter.[1]

Mechanical analogue

Fig. 3 is a photograph of a mechanical analogue of a meter run and provides a clear visual picture of the way in which a wave propagates through an orifice. It is similar to the mechanical models used by geophysicists for illustrating the propagation and reflection of vibrational shock waves through different strata in the earth's crust.

Compressional waves can be made to travel down the "pipe" (spring) by suddenly releasing energy stored in the compression of a few turns of the spring at one end of the "pipe." Upon reaching the "orifice" (a mass in the form of a ring) a fraction of the wave energy will be reflected. The on-going or transmitted wave can be seen to be less intense and careful scrutiny will reveal that a phase difference has been introduced between incident and transmitted waves at this point. A change in "β ratio" is easily accomplished by increasing the mass of the ring by insertion of another ring which reduces the size of the orifice "aperture."

Effect of phase shift on differential pressure

Fig. 4 illustrates the instantaneous pressure distribution in the vicinity of an orifice under a condition of pulsative flow. The recurrent pulse wave, traveling from left to right, is assumed to be sinusoidal. It may be a single component of a complex wave. Notice particularly the phase shift and reduction of pulse amplitude as previously described.

The incident and transmitted waves can be described mathematically as

$$p_1 = P_1 + A \sin \omega t \quad \text{(incident wave)} \quad (3)$$

$$p_2 = P_2 + B \sin (\omega t - \varphi) \quad \text{(transmitted wave)} \quad (4)$$

where

p_1 and p_2 are, respectively, instantaneous pulsation pressures at upstream and downstream orifice taps.

P_1 and P_2 are, respectively, static pressures (with no pulsation present) at upstream and downstream orifice taps.

A and B are, respectively, peak amplitudes of upstream and downstream pulse waves.

$\omega = 2\pi f$ where f is pulsation frequency

φ = phase shift

The instantaneous differential pressure is obviously

$$\Delta p = p_1 - p_2 = (P_1 - P_2) + A \sin \omega t - B \sin (\omega t - \varphi) \quad (5)$$

Effect of phase shift on time averaged differential pressure

The effect of φ on the time-averaged value of Δp is zero.

When Raymond C. Baird joined the research and development department of Fluor Corp. early in 1946, he brought with him a background of education that included a B.A. degree from UCLA, a BS degree in meteorology and an MS in Physics at California Institute of Technology. He had also seen military service in World War II.

During his employment at Fluor he has been actively engaged in research, design, and development work in the fields of electronics, gas cleaning, heat exchange, acoustics, and in all phases of the general field of fluid dynamics, with particular emphasis on the study and analysis of problems involving vibration and pulsative flow in both gas and liquid systems. In addition, he directed all the activities of a rather well-equipped mobile research laboratory used for the prosecution of field surveys involving the dynamics of fluid systems and mechanical structures.

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Electric Resistance and Fusion Weld—Plain End	14" to 18" O.D.	Up to 40'	.250" to .500"	Napa, Calif.—Basalt-Kaiser
Electric Resistance Weld—Plain End	5⅝" to 12¾" O.D.	Up to 55'	.188" to .375"	Fontana, Calif.
Electric Fusion Weld—Expanded—Plain End	20" to 30" O.D.	Up to 40'	.250" to .500"	Napa, Calif.—Basalt-Kaiser

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This can be shown by integrating the expression for Δp over a complete cycle of from $(t = O)$ to $(t = T)$ where $(T = 1/f)$, and dividing by T thus

$$(\Delta p)_{ave} = \int_0^T \frac{p_1 - p_2}{T}\, dt \tag{6}$$

$$= 1/T \int_0^T [P_1 + A \sin \omega t - P_1 - B \sin (\omega t - \varphi)]\, dt \tag{7}$$

$$= (P_1 - P_2) + (A/\omega T)\,(1 - \cos \omega T) + (B/\omega T) \times [\cos (\omega T - \varphi) - \cos \varphi] \tag{8}$$

Thus $(\Delta p)_{ave}$ is made up of the "static" component $(P_1 - P_2)$, plus a dynamic component. However, since $(T = 1/f)$, and $(\omega = 2 \pi f)$, equation (8) breaks down immediately to

$$(\Delta p)_{ave} = (P_1 - P_2) \tag{9}$$

and, accordingly, one would be inclined to think that pulse phase shift and intensity loss have no effect on flow meter accuracy.

Effect of phase shift and intensity loss on flow rate

To help understand how pulsation can produce error in a time-integrated flow-meter chart, it will be helpful to put equation (5) in a simpler form. Expansion of the trigonometric terms and factoring gives

$$\Delta p = (P_1 - P_2) + (A - B \cos \varphi) \sin \omega t + (B \sin \varphi) \cos \omega t \tag{10}$$

$$= C + A' \sin \omega t + B' \cos \omega t \tag{11}$$

where

$C = (P_1 - P_2)$, the "DC"[1] or static component

$A' = A - B \cos \varphi$ and $B' = B \sin \varphi$ These taken together constitute the "AC"[1] or dynamic component.

The dynamic portion of equation (11) can be replaced by one involving a single trigonometric term by finding the peak value of $(A' \sin \omega t + B' \cos \omega t)$ at a point where $[(w t) = \sigma]$. σ is the phase angle for the new equation and is determined by setting the first derivative of the dynamic portion of equation (11) equal to zero, i.e.

$$\frac{d}{dt}(A' \sin \omega t + B' \cos \omega t) = 0 \tag{12}$$

$$A' \cos \omega t - B' \sin \omega t = 0 \tag{13}$$

$$\frac{\sin \omega t}{\cos \omega t} = \frac{A'}{B'} = \tan \sigma \tag{14}$$

$$\sigma = \tan^{-1} (A'/B') \tag{15}$$

The amplitudes of $(A' \sin \omega t)$ and $(B' \cos \omega t)$ at $(\omega t = \sigma)$ are, respectively,

$$A'' = A' \sin \sigma \quad B'' = B' \cos \sigma \tag{16}$$

The peak amplitude of the combined waves is

$$D = (A'' + B'') = A' \sin \sigma + B' \cos \sigma$$

and the final form of the "AC" or dynamic component of (Δp) becomes

$$(\Delta p)_{AC} = D \cos (\omega t - \sigma) \tag{17}$$

therefore

$$(\Delta p) = C + D \cos (\omega t - \sigma) \tag{18}$$

and we see that the differential pressure during pulsative flow varies above and below a mean value, C, by as much as D. This oscillatory amplitude as well as σ is a function of phase shift and intensity loss through the orifice as shown in the following equation (from equations 11, 15, and 16)

$$(\Delta p) = (P_1 - P_2) + [(A - B \cos \varphi) \sin (\tan^{-1} A/B) + B \sin \varphi \cos (\tan^{-1} A/B)] \times \cos (\omega t - \tan^{-1} A/B) \tag{19}$$

This shows that the D factor of equation (18), the amplitude of the oscillating or dynamic portion of Δp, generally increases with increased phase shift and intensity loss. If, as before, equation (18) is integrated to find the time-averaged value of (Δp) we obtain the same result indicated by equation (9).

Dependence upon orifice equation

However, if it is assumed that the orifice equation holds true at any instant during the pulse cycle so that

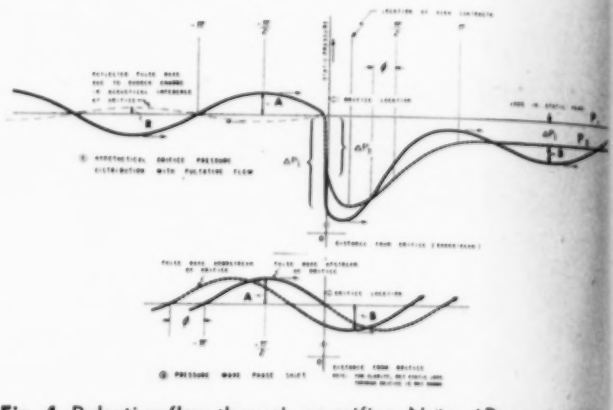

Fig. 4. Pulsative flow through an orifice. Note: ΔP_s = static loss w/no pulsation $-\Delta P_i$ = instantaneous loss w/pulsation present.

$$Q = k\,(\Delta p)^{1/2} \tag{20}$$

where

Q = flow rate

k = a constant

Δp = pressure drop across orifice

then the total quantity of fluid flowing through the orifice in one cycle is

$$\omega = \int_0^T Q\, dt = k \int_0^T (\Delta p)^{1/2} = k \int_0^T C + D \cos (\omega t - \sigma)^{1/2}\, dt \tag{21}$$

The important factors in this integral insofar as pulsation is concerned are σ and particularly C because these have been shown to be dependent in large measure upon pulsation intensity and orifice β ratio. Because it enters as a square root function, the dynamic component of (Δp) does not drop out when integrating to find the quantity of flow during a complete cycle. The reason for this can be easily grasped by reference to *Fig. 5*. Curve A shows the variation in flow rate during the cycle where $Q_A = k\,(\Delta p)$. Q_A is the corresponding average rate for the cycle. It would have the same value regardless of whether or not pulsation were present. Curve B shows the variation where $Q = k\,(\Delta p)^{1/2}$. The average rate in this case, Q_B, will obviously be less than Q_A, because the exponent of (Δp) is < 1.

It is apparent from equation (21) and *Fig. 5* that the

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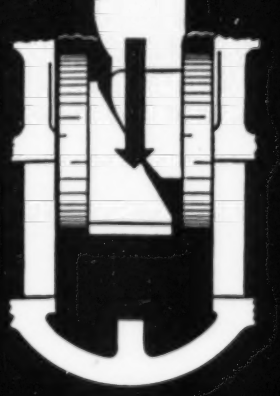

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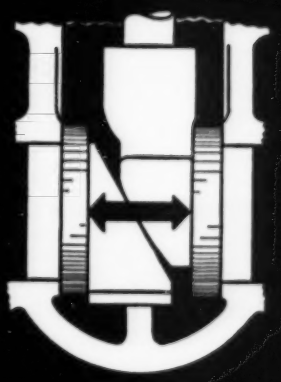
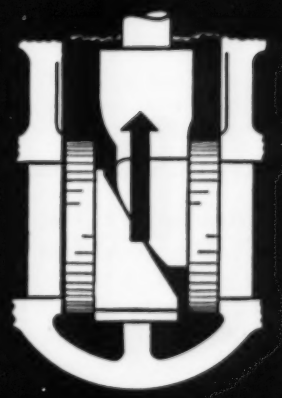


CLOSED. Faces of upper wedge are radiused and faces of both wedges are transversely beveled for equalized wedging pressure and *tight closing despite valve body distortion.*



RISING. Wedging pressure on both discs is released before discs start to rise. Complete absence of wedging pressure during travel of discs assures easy operation, tight closing and greatly prolonged valve life!

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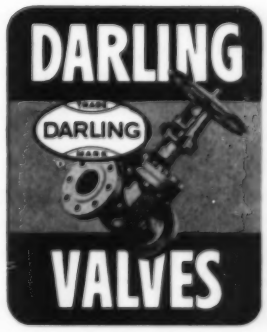

FOR PLUS VALUES, JOB-PROVED AGAIN AND AGAIN

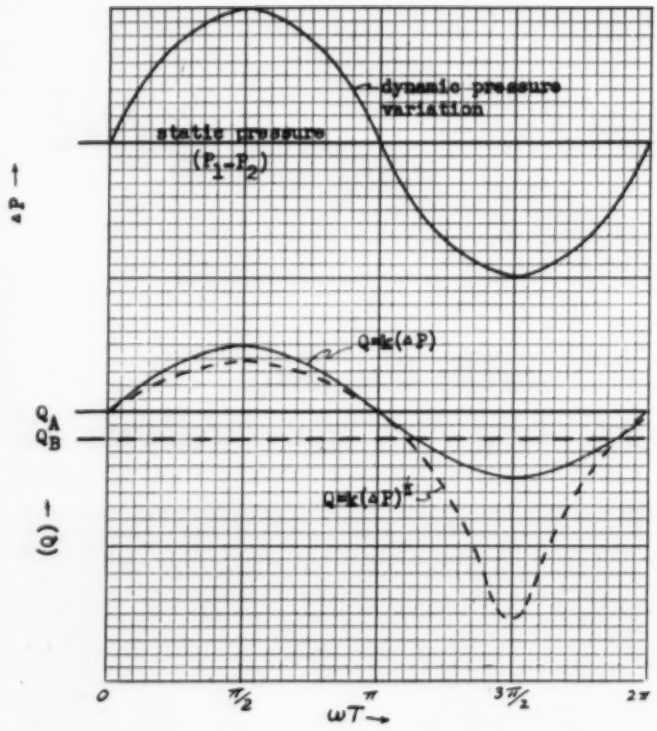

Fig. 5. Effect of differential-pressure oscillation on integrated flow.

amount of flow error is a function of the relative magnitudes of C and D. The smaller C is as compared to D, the larger will be the error. This is another way of saying what has been observed for many years in the field: that increasing the average differential pressure by using a smaller orifice will, in general, reduce metering error.

The result of pulsative flow

The resultant effect, therefore, of the presence of dynamic component in (Δp) is to increase the effective pressure drop through the orifice for a specified time-averaged flow rate. Accordingly, if pulsation is suddenly introduced in a system containing an orifice meter the maintenance of the same actual flow rate requires that one or the other of the following possible readjustments of upstream and downstream mean static pressures takes place.

(1) $\begin{cases} P_1, \text{ increase} \\ P_2, \text{ remain the same} \end{cases}$

(2) $\begin{cases} P_1, \text{ remain the same} \\ P_2, \text{ decrease} \end{cases}$

(3) $\begin{cases} P_1, \text{ increase} \\ P_2, \text{ decrease} \end{cases}$

(3) is most likely to occur.

The average orifice meter operates with a differential pressure, (Δp), on the order of only 25 to 50 in. of H_2O at a static pressure measured in hundreds of psi. Hence, the slight alterations in upstream and/or downstream static pressures necessary to maintain the same flow rate after the imposition of pulsative flow would be so small as to make their measurement extremely difficult. These slight alterations, however, would appear at the flow meter as an appreciable percentage of the differential pressure. The result would be an error in the indicated differential pressure at the flow meter which would render inaccurate any flow quantity calculations based upon integration of the flow meter chart.

Remedy

There are obviously two courses of action to take in eliminating orifice-meter error caused by pulsative flow. One is to develop some complicated and expensive means to measure the amount of error and then apply the necessary corrections. It should be quite apparent, in light of the material contained in this article, that this approach would be very likely expensive and time-consuming.

The best approach, on the other hand, would appear to be the elimination of pulsative flow, since the orifice meter as it stands has, over a long period of time, proven to be both accurate and dependable when operating under steady flow conditions.

Conclusion

Although nothing has been said relative to the self-generation of pulsation by a meter-run installation, acoustical resonance of the lines connecting flow-meters to orifice taps, or the effect of pulsation on the flow-meter itself,[1] it should be quite apparent that the primary difficulty in metering pulsative flow is due to acoustical reaction of the orifice to pulsation.

Therefore, it would seem that if orifice metering is to be used for flow measurement, steps should be taken to insure that compressor-induced pulsative flow is at a minimum. This can be accomplished in several ways, chief of which in order of preference, being:

1. The isolation of meter runs from sources of pulsation by means of filter-type pulsation dampeners.
2. The reduction of pulsation amplitude by installation of adequately sized surge chambers.[4]
3. The reduction of pulsation in the meter run by either "pinching back" on block valves located between meter runs and pulsation sources or inserting pressure-dropping orifices at such locations.

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This article is adapted from a talk delivered at the instrument short course sponsored by the Los Angeles Harbor Junior college and Southern California Meter Association, Nov. 19-20, 1953.

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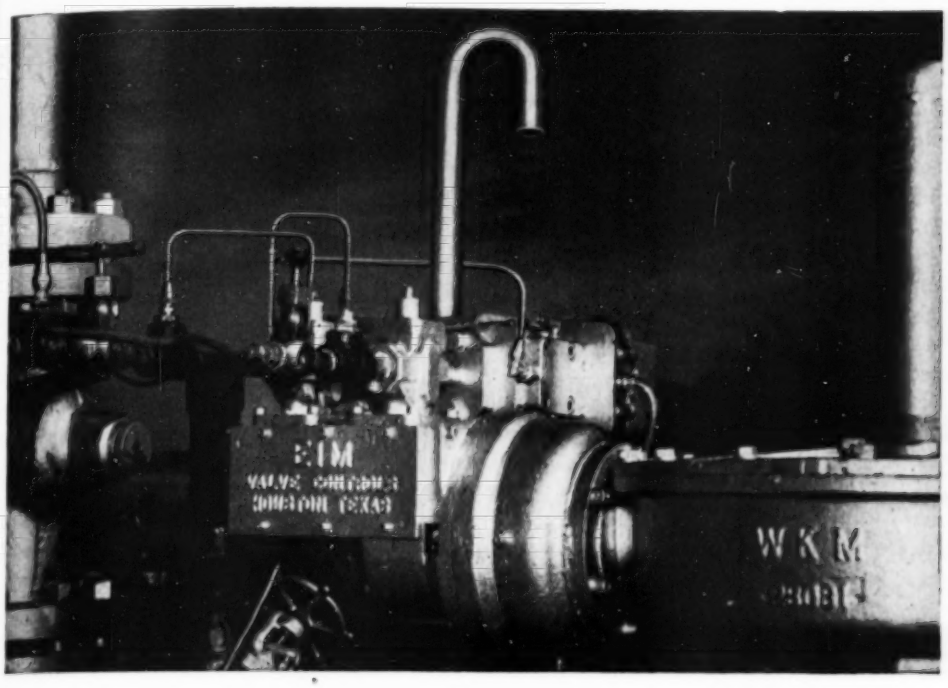

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STRAIN GAUGE: promising tool for the gas pipeline industry

An explanation of the way in which the wire gauge works and some suggestions for its application in gas installations.

By **NORMAN L. MEYERSON** • Worthington Corp., Harrison, N. J.

RECENT developments in instrumentation and electronics have given us many devices and systems to measure material performance in terms of mechanical variables. Basic operation of one such device gaining in usefulness today dates back to the earliest days of electrical knowledge. Although no larger than a postage stamp, it has proven to be one of industry's most versatile, dependable and accurate tools for translation of static and dynamic displacements into electrical quantities. By this means, the *bonded resistance—wire strain gauge* enables the precise measurement of displacement, load, surface strain, temperature, torque, pressure, flow, and a host of other variables.

As early as 1856 Lord Kelvin established that an increase in strain on metal wire directly affected the flow of current passing through the wire. He found that resistance to current flow increased with increased strain. The later established relationship,

$$R = \rho \frac{L}{A}$$

R = the resistance of the wire in ohms.
ρ = resistivity of the wire in ohm-cm.
A = cross-sectional area of wire in sq cms.
L = wire length in cms.

. . . indicates the basis for Lord Kelvin's observations.

Since the ratio L/A obviously varies with stress when a length of wire is affixed to two points on a machine member, any tension or compression force acting on the member in a direction other than normal to the wire axis produces a proportional change in the electrical resistance of the wire. The wire used as a strain gauge must be fastened to the test piece so that:

a. no electrical short exists between the wire tie-points,
b. it is drawn taut between the tie-points, and
c. the member under test is not changed or affected by the addition of the tie-point wire holders.

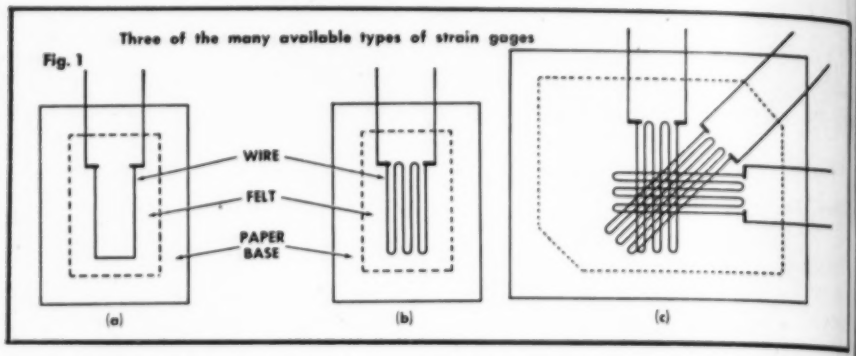


Fig. 1. Three of the many available types of strain gauges. Left: simple type; center grid type; right, rosette type.

These three requirements of a good strain measuring device were recently realized in the now popular bonded strain gauge. A simple strain gauge of this type is illustrated in *Fig. 1 (a)*. Additional requirements became evident as use of the gauge became widespread. First, the wire used must be small in diameter giving the fairly high resistance needed for electrical bridge operation (described later in this article), and to effect a high ratio of bonding area to cross-sectional area. Second, the wire must not be brittle and have as low a temperature coefficient of resistance as is practical. Temperature corrections are usually employed (also described later in this article) to offset bridge unbalance when these gauges are used. Third, the resistance change should be linear up to relatively high strains. This is not an actual requirement but is preferred for ease in handling data and in setting up automatic recording devices.

The mounting of a strain gauge involves no particularly elaborate procedure. The surface must be even and not too smooth. Surfaces having a 16 microinch finish (Profilmeter) or less should be roughened with 180 grit paper. A light sandblast gives an excellent surface. Solvents should be used to remove oil and wax. Application of the gauge involves the use of nitrocellulose cement for temperatures below 150° F and polymer cements (Bakelite) for higher temperatures. Curing normally takes from 10 to 12 hours at room temperatures, or shorter if at elevated temperatures. Water-proofing is accomplished by the addition of coatings such as ceresin wax, Neoprene, silicone grease, and petroleum jelly. Strain gauge manufacturers supply detailed instructions for preparation and mounting with equipment.

Since the change imposed by a force on the gauge is resistive, we can use a simple ohmeter type of measurement impressing a d.c. potential across the gauge and observing the resultant current. By application of Oms Law, i.e. $R = \frac{E}{I}$ where E is the applied voltage and I is the measured current in amperes, the resistance is readily calculated. However, this method is very

This article is based on articles appearing in current issues of *Power and Fluids*, a Worthington Corp. publication.

rarely used because of the small change in resistance per unit strain. The Wheatstone bridge circuit is almost exclusively used today.

The basic bridge circuit is shown in *Fig. 2* together with its fundamental relationship. These proportional quantities are shown for the specific case where a d.c. potential is used. When an a.c. bridge is used, the capacitive and inductive reactances of the resistors and leads must be balanced out by external compensation or internal non-active capacitance. Both d.c. or a.c. bridges are used with equal success. Amplification of the unbalanced d.c. bridge voltages has been, until recently, difficult to accomplish because of the relative instability of d.c. amplifiers.

In bridge metering of strain gauge response, the strain gauges themselves are the resistor legs, as shown in *Fig. 2*. From the relationships of bridge performance, we see that a change in resistance of any one gauge results in an unbalance voltage. Also note that if the adjacent resistances R_1 and R_2 were increased and decreased respectively by the same amount, twice the unbalance voltage of one leg change will be observed between B and B^1. Furthermore, an increase in resistance of R_1 accompanying the same increase in resistance of R_4 produces no change in bridge balance.

This adjacent leg relationship is extremely useful when temperature compensation and voltage amplification is desirable. To best illustrate this, refer to *Fig. 3*. In case I, temperature compensation is automatic since both R_1 and R_2 are at the same temperature. If both sides of the cantilever are not at the same temperature, additional compensating gauges are necessary.

For case II, two additional gauges are required to provide compensation. In case III, compensation is automatic since all bridge legs are at the same temperature.

The sensitivity of the wire strain gauge, or "gauge factor" as it is commonly called, is the ratio of the change in resistance to the strain; i.e., gauge factor $= \Delta R/R \div \Delta L/L$ where R and L are the unstrained resistance and length respectively. Dobie and Isaac show in *"Electric Resistance Strain Gauges"* that the gauge factor for small strains is approximately $1 + 2\Delta R/R$.

With regard to stability, manufacturers claim favorable response when mounting techniques are carefully executed. The drift of the zero and hysteresis under load has been thoroughly investigated and found to be negligible.

By judicious arrangement of gauges on the test piece, we can automatically eliminate effects other than those desired. In case I *(Fig. 3)*, if the force (F) is applied as shown, R_1 and R_2 are in tension and compression respectively, producing an unbalanced bridge voltage. However, if an axial force (C) were applied as shown, both R_1 and R_2 would be in tension, thereby maintaining a balanced bridge. By rearranging the gauges, axial strains can be measured, with the effect of bending strains eliminated (case II) since R_1 and R_5 become part of the same leg of the bridge. When a force or force component (D) acts on the case II cantilever, R_1 is in tension and R_5 is in compression, and since these two gauges are in series in the A-B leg, their respective increase and decrease in resistance cancel, thereby having no effect on the balanced bridge.

Case III permits measurement of torsional strains with automatic temperature, bending and axial strain compensation.

Bending and axial strain compensation is only complete if the strain gauges are mounted on helices 45° to the torsional axis (see *Table 1*, in relation to *Fig. 3*).

Determination of weight, pressure and flow are made in a secondary manner. For example, weight is measurable using a strain-gauge-fitted cantilever with the weight acting in the direction of (F) in either case I or II of *Fig. 3*. For measuring pressure, strain gauges mounted on sections of tubing blanked at one end or on thin metal diaphragms are appropriate.

Cells of the type shown in *Fig. 4* con-

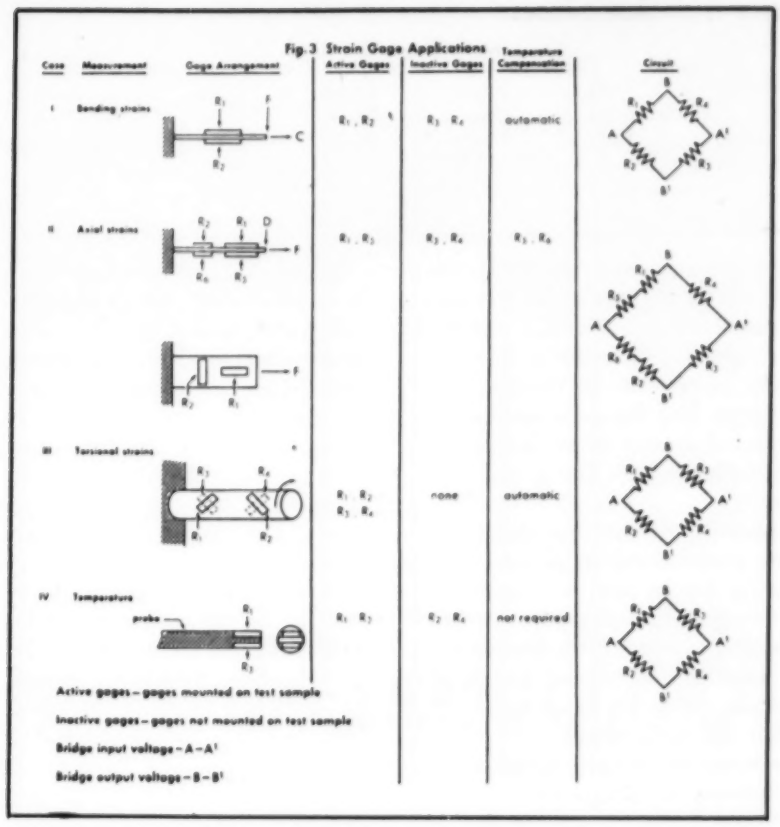


Fig. 3. Strain gauge applications.

Fig. 2. Basic bridge relationship and its fundamental relationship.

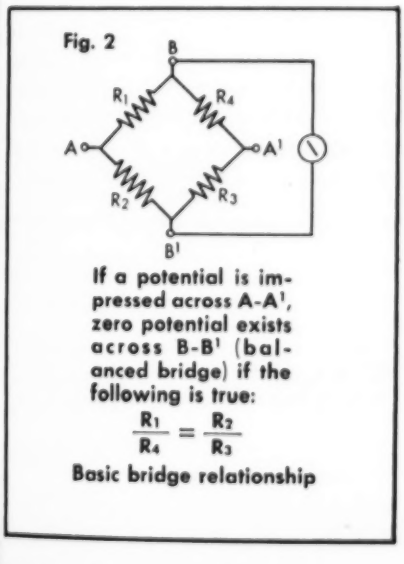


TABLE 1. STRAIN GAUGES

Force	R_1	R_2	R_3	R_4	Bridge
Bending	Tens.	Tens.	Comp.	Comp.	Balanced
Axial	Tens.	Tens.	Tens.	Tens.	Balanced
Torsional	Tens.	Comp.	Tens.	Comp.	Unbalanced

Tens. = Tension.
Comp. = Compression.

sist of a pressure sensitive tube on the outside of which special SR-4 strain gauges are bonded. Pressure changes may be measured by means of electrical indicator or recorder of the potentiometer type, but the cells are usually connected to operate an oscilloscope or oscillograph for high frequency response.

Application of the thin metal diaphragm pressure cell to primary flow measuring devices such as venturi meters, orifices and nozzles provides flow measurements which are considerably more accurate and precise than commonly used Bourdon gauges and "U" or single leg manometers.

The versatility of these simple sensitive elements is exemplified in many ways. Case I, *Fig. 3*, is used for the measurement of displacement weight, force and speed. Applications commonly in use at Worthington include dynamometer load beams, shaft displacement indicators, and revolution counters. In a similar manner case II is usable for force and weight. The torsional strain arrangement (case III) has found widespread use in the form of in-line torque measuring devices.

Marketed as "torquemeters," these instruments measure transmitted torque irrespective of the driver efficiency. The use of gear box and belt losses, and turbine calculations are unnecessary when an in-line torquemeter is used. Most torquemeters are manufactured with reduced area gauge sections in order to realize a greater twist angle since the twist angle is directly proportional to the applied torque and inversely proportional to the fourth power of the gauged section area (for any round shaft).

In the field of vibration the three strain measuring cases are used in measuring and recording linear and torsional vibrations. We can observe not only frequencies down to zero cycles per second but also the shape of the vibrational waves. Additional data such as acceleration and velocity are obtained by applying the displacement wave to electronic differentiation circuits.

In most strain investigations the directions of the maximum and minimum principal strains are not known. To determine them three gauges may be used, each oriented 45° from each other on axes having as their origin the point in question. However, manufacturers also supply rosette gauges *(Fig. 1c)* to eliminate the necessity for using more than one gauge.

The test and mathematical techniques with the use of the rosette gauge have been thoroughly developed and are treated in many papers and books currently available. By means of three simple rosette strain measurements it is a simple matter to calculate the three axial strains, the maximum and minimum principal strains, the principal strain directions, the axial stresses, the maximum and minimum principal stresses, and the maximum shear stress.

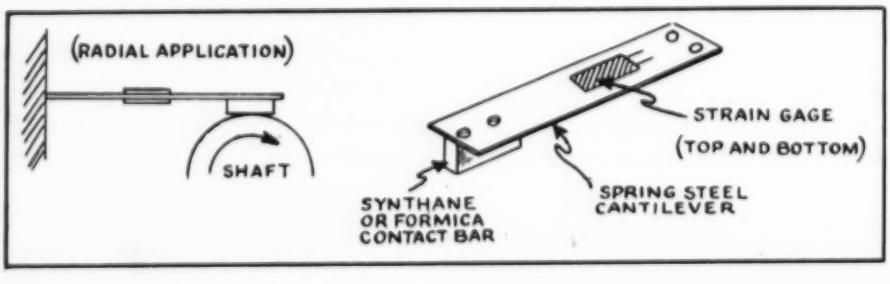
Temperature measurements (case IV) can also be made with strain gauges. Because of the principal function of the strain gauge to measure strains and to be as insensitive to temperature as is practical, the strain gauge wire is basically one with a low temperature coefficient of resistance. This means that the wire displays a very small change in resistance for a relatively large change in temperature. The

Fig. 4. The SR-4 high-frequency pressure cells are designed for 50% higher output, using voltages as high as 25. Special materials are used for the sensitive unit to meet high frequency requirements. Cells are approximately 5½ in. long overall, 2 in. in diameter, and weigh 1 lb.

change in resistance of the strain gauges of a Wheatstone bridge cannot therefore be conveniently used for temperature measurements directly. Instead, by placing the gauges on a material that has a high coefficient of expansion they can be made to indicate temperature in response to changes in dimensions. The use of such higher coefficient materials as aluminum, phosphor, bronze, lead, tin, and zinc will result in maximum temperature sensitivity.

Another method would be to put the strain gauges on the top and bottom sides of a strip bimetallic element. As the temperature sensed by the element changes, the difference in expansion coefficient between the dissimilar metals will cause the strip to bend. The strain gauges will then be subject to compressive and tensile strains set up by the bending of the element and thereby un-

Fig. 5. Strain gauge cantilever.



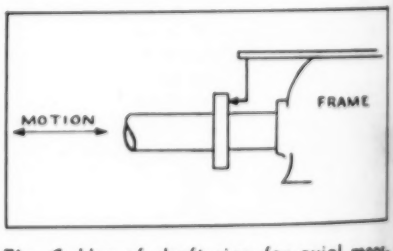
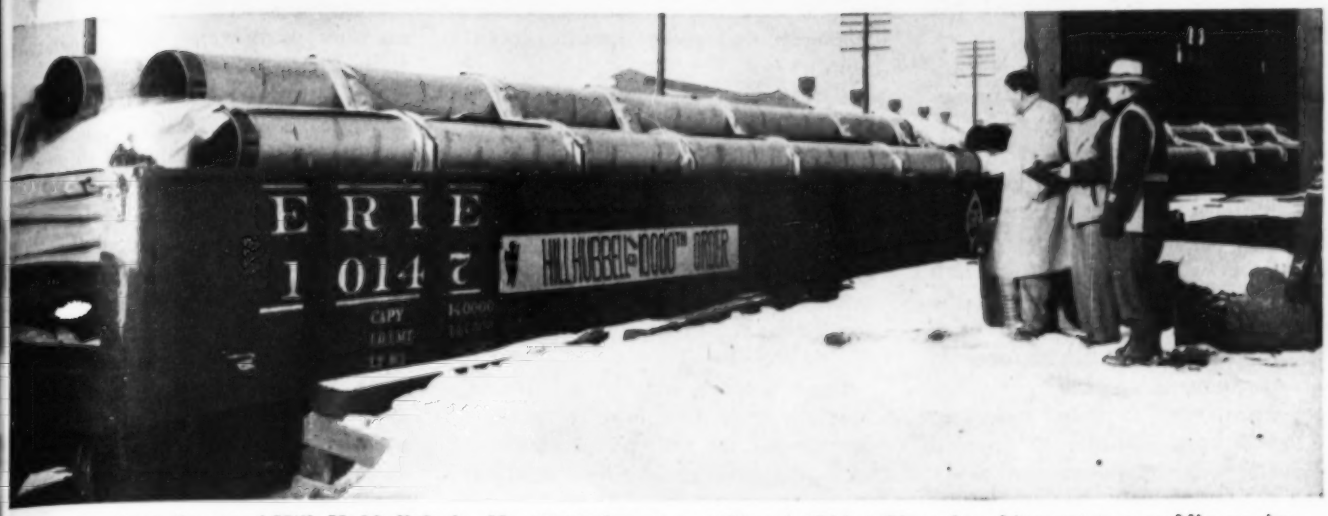


Fig. 6. Use of shaft ring for axial measurement.



The first installment of Hill, Hubbell Order No. 10,000 leaves our Girard (Ohio) Plant for shipment to a public service company in Colorado. This order consisted of 12 carloads of 20" pipe for a supply line in Denver. Through the years, Hill, Hubbell shipments have ranged from single carloads to whole trainloads of coated and wrapped pipe.

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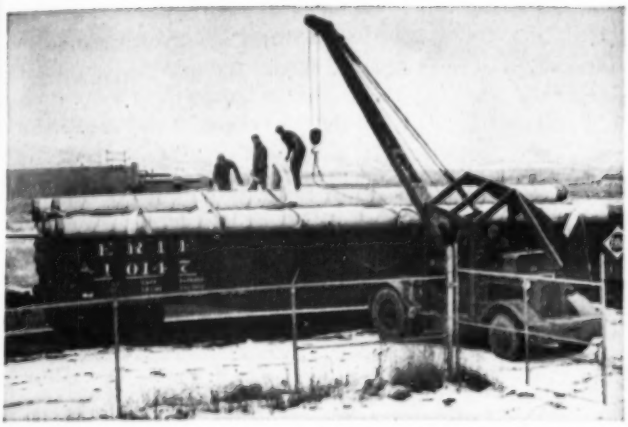

Here the first carload (Erie 10147) of Hill, Hubbell Order No. 10,000 is being unloaded by workmen of the Public Service Company of Colorado in Denver. On time, as usual.

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balance the Wheatstone bridge.

Through the use of accessory electronic equipment, the minute bridge voltages are amplified to permit observation of small strains with exceptional accuracy. As an example, a manufacturer of "torquemeters" guarantees his instrument to be accurate to ± ⅓ of 1% of the full load rating from zero to one-third load and ± 1% of the reading from one-third to full load rating. Worthington uses a number of these instruments covering a range from zero to 4000 ft lb and speeds up to 15,000 rpm. Calibration revealed accuracies better than those guaranteed. Tests made using the same instruments under the same load conditions one year apart revealed no detectable difference in test results.

The versatility of the strain gauge is the aspect most revered by engineers and technicians in their day-to-day contact with this valued tool. Less known applications of the strain gauge aid in procuring information heretofore difficult to obtain. In addition to those applications already cited, it is possible to apply strain gauges to obtain measurements of axial travel, runout, critical speeds, axis translation, and the speed of rotating members instantly, simultaneously, and under dynamic conditions.

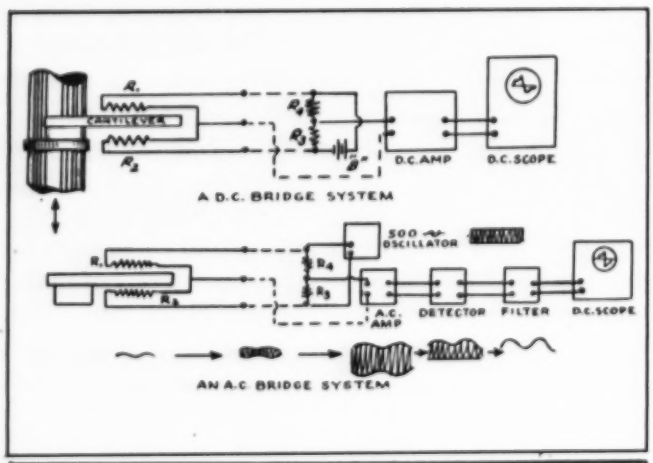
For all these measurements strain gauge cantilevers such as described for bending strains (case I) are all that are required in addition to a voltage source and a means of viewing the unbalance voltages such as an oscilloscope or oscillograph. The cantilever is of spring steel and has a Synthane or Formica contact bar rigidly attached to the contacting end *(Fig. 5)*.

Physical dimensions depend entirely upon the application; however, it is important that the spring steel cantilever be so positioned as to provide sufficient contact bar preloading to permit it to follow the motion of the unit to be tested without bounce.

In order to observe and record the amount of axial travel, a strain gauge cantilever is applied so as to be sensitive to axial motion, only, relative to some stationary part of the machine. The contact bar end of the cantilever is made to bear against the back of a coupling hub or a ring put on the shaft expressly for the purpose of exploring dynamic rotor operation *(Fig. 6)*. When the rear of the cantilever is attached rigidly to the frame of the machine under test, the axial motion of the rotor, as measured, will be relative to the frame *(Fig. 6)*.

Calibration is easily accomplished by providing known axial displacements and measuring the resulting bridge unbalance. Observation on an oscilloscope screen will permit quantitative as well as qualitative analysis of the axial motion. If d.c. excitation of the bridge is used, an oscilloscope with a d.c. input will be required. Amplification of the weak unbalance voltages can be obtained by employing the use of a strain gauge amplifier (d.c.) as a separate unit between the bridge and the oscilloscope or the internal d.c. amplifier of some of the better available oscilloscopes. While permitting the use of more stable, simpler, and less expensive amplifiers, a.c. bridge excitation requires the use of impedance compensators to balance out distributed and lead capacitances. In addition, detector and filter sections are required to resolve the a.c. modulated waves to single amplitude waves for observation or recording.

Strain gauge amplifiers employing the use of carrier frequencies from 500 to 5000 cps are commercially available. The choice of carrier frequency is dictated by the nature of the variation to



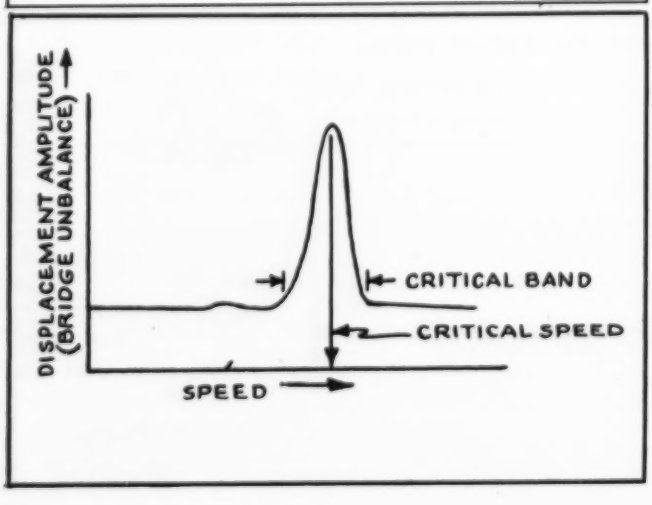
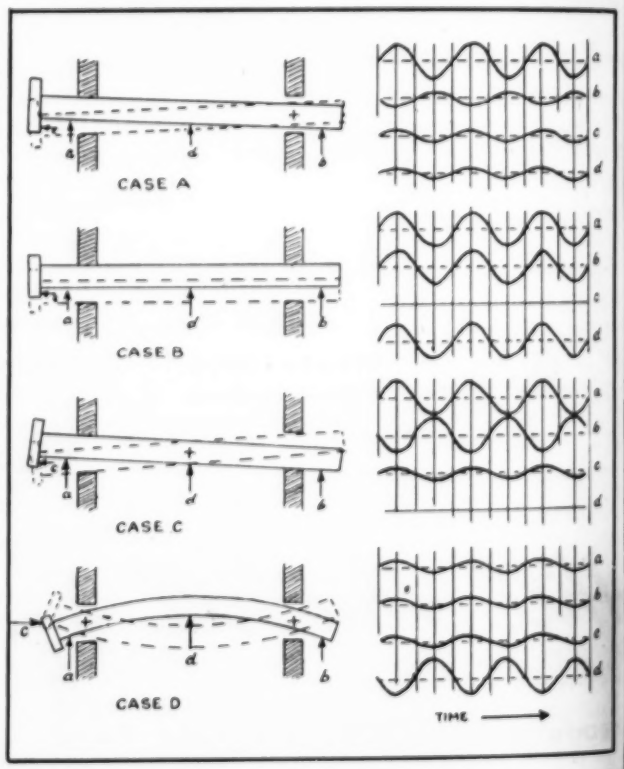


Fig. 7 (left). Bridge systems.

Fig. 8 (below). Examples of oscillograms for several types of shaft motion.

Fig. 9 (below left). Typical shaft resonance curve.



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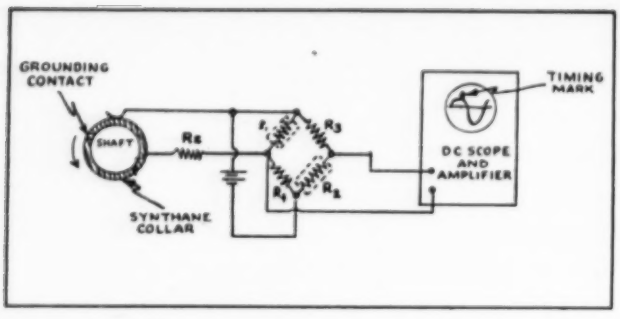

Fig. 10. Timing marker for oscilloscope patterns. R_1, R_2 = active strain gauge on axial or radial cantilevers. R_3, R_4 = inactive gauges mounted on common piece of steel away from rotating machine. R_5 = unbalancing resistance for timing marks.

be measured. Slow periodic or aperiodic axial motion can be handled conveniently with either a d.c. or an a.c. bridge system *(Fig. 7)*. Maximum sensitivity is realized when all four legs of the bridge are of equal resistance. The d.c. supply voltage for the d.c. bridge system should be high enough to provide a sufficient unbalance voltage to be acted upon by the amplifier yet should be low enough to avoid overheating of the strain gauges. Data on safe working voltages for various size gauges are available from the strain gauge manufacturers.

Should the resulting wave of axial travel be periodic and it is desired to know the frequency of the variation, several systems may be employed. First, the unknown wave can be beat against a known variable frequency on the oscilloscope directly. Procedures for this type of analysis are described in operating instructions for all oscilloscopes. Second, a synchronizing timing mark may be employed to provide distinct timing intervals on the screen of the scope. Description of such a device is given later in this article. Third, the unbalance waveform can be fed into a waveform analyzer which will indicate the basic and harmonic frequencies directly. The third procedure is generally only practiced where axial travel of a rotor is of serious nature and warrants the purchase of waveform analysis equipment. Axial travel measurements are useful on all floating shaft machines whose shaft positions are dictated by magnetic fields or hydraulic balancing members.

By placing a pair of strain gauge cantilevers to act radially at the exposed ends of a rotating member, it is a simple matter to establish the nature of the shaft's radial motion. Through the use of an electronic switch the movement of each end of the shaft is viewed simultaneously on a single oscilloscope screen. In this manner runout and axis translation can be identified.

In the event the response of more than two cantilevers is required, it is preferable to use separate amplifiers for each cantilever and record the resulting amplified waveforms on a multi-channel magnetic oscillograph. *Fig. 8* illustrates typical oscillograms obtainable with a multi-channel oscillograph on rotors exhibiting various forms of dynamic action other than the ideally smooth operation every manufacturer strives to achieve. Curve "a" represents the motion of the rotor at "a" taken radially just left of the left bearing. Curve "b" is the recording of the radial displacement at "b" taken just right of the right bearing. Curve "c" represents the coupling motion taken axially just left of "a". Curve "d" is a recording of the radial displacement of the center of the rotor taken mid-way between the line bearings. While the drawings of the shaft action are of exaggerated proportions, those of the oscillograms are not. With amplification, enlarged waveform of the dynamic displacements can be achieved easily. Magnetic oscillographs have timing lines automatically placed upon the sensitive film or paper as records are made. The speed of the rotor is easily computed from these timing marks.

Case (A) of *Fig. 8* may come about because of coupling misalignment or unbalance and is characterized by a large radial displacement at the coupling end of the shaft with an out-of-phase radial displacement at the other end. Cases (B) and (C) may come about because of misalignment of couplings on bearing-supported spacer shafts. Case (B) illustrates misalignment in the same direction and case (C) in opposite directions. Unbalance of the rotating mass between the bearings may give rise to case (B) translation or a pattern similar to case (D). The cantilever placed radially at the center of the shaft span between the bearings will indicate when the first critical speed is obtained. A plot of bridge unbalance versus speed will produce the typical resonance curve of the first critical *(Fig. 9)*. Higher order criticals are recorded by shifting the cantilever to points on the shaft to correspond with the maximum amplitudes to be obtained.

Through the use of an insulated collar made of Synthane or Micarta, surfaces are provided whereby axial and radial displacements can be measured simultaneously. A grounding contact through the collar provides an artificial unbalance on the measuring bridges to create a pulse on the oscilloscope screen once every revolution. These pulses represent timing marks which are used to determine the speed of the shaft and also to provide a reference point on the shaft to aid in the localization of regions contributing to erratic mechanical or hydraulic performance *(Fig. 10)*.

Some uses one gas company found for the strain gauge

Just what has the subject of strain gauges to do with the gas industry? What are its applications, actual and potential?

Hale C. Goodrich of United Gas Pipe Line Co., Shreveport, is convinced the uses are manifold. In a talk before the ASME Petroleum Mechanical Engineering conference last year in Houston he told of some of his own experiences with these devices:

The fact that measurements of strain are made in micro-inches or millionths of an inch places the problems in the light of ridiculous refinement, in the minds of many. Don't be misled. Remember that a strain of 500 micro-inches in steel means a stress of nearly 15,000 psi. That is more than would be allowed in the design of some structural members in compression, yet temperature misalignment or eccentricity might easily cause this much stress on many of the pipes or structures used by us.

You may think that stress analysis is only useable in isolated cases which are problems of a highly technical nature. That is only a small portion of the story. Let me give you an example.

After hunting for a suitable place to experiment with bonded wire strain

gauges, we selected a compressor station conveniently located in the area near our general office. I went out to look over the station. I'll admit I didn't know just where to begin. As in many stations, there were vibrations in small pipes, large pipes, valves, nipples, and concrete. We discussed the various means of attack. Finally it was decided to cement gauges on a lot of the points of vibrations. We did this and found that our station under certain operating conditions was dancing to the tune of one million vibrations every eight hours. You might think that to be enough to shake anything apart.

Well, we found one 2-in. nipple that was connected to a piece of equipment by means of a flange and to a header by means of a saddle. The saddle broke but the nipple did not. We measured about 12,000/sq in. vibration stress on the nipple. Under the allowable working pressure this made the stress go to more than the allowable but not over about 30,000 psi. This would not break the nipple. However, there is bound to be some welding stress in a welding saddle.

Fatigue limit exceeded

Assuming that to be the case and also assuming that 1% of the vibrations went to the maximum, it can easily be believed that the stress in the saddle exceeded the fatigue limit quite often. It is logical to believe that failure of the saddle was due to fatigue. This was only a small nipple but there are, no doubt, more points of doubtful stress in that station.

For example, the discharge nipple from the compression cylinder goes down into the discharge bottle about 3 ft below the cylinder. The discharge bottle is supported on brackets placed under it with ¼-in. neoprene pads between the support and the pipe. There is a temperature change of about 100° F between shutdown conditions and operating conditions. At certain operating conditions the station vibrates more than at others. When this excessive vibration occurs, the station operators tighten up on the supports to stop the vibration. This takes up the slack provided by the neoprene, but also confines the expansions of the riser discharge bottle and cylinder.

Gauges were placed on the riser to see if the amount of expansion of the riser could be measured. Considerable difficulty was encountered in making the strain gauge measurements because of temperature effects on the gauge and the rate of heat transfer being very low. At this point we had determined that a problem existed.

A temperature-compensated gauge was then placed on the riser and measurements taken. Measurements showed that the tightening of supports did prevent expansion to some extent, that the tightening should not be too excessive and should only be done after the pipe had heated to its full expansion. The expansion due to temperature and pressure could stress the riser to 18,000 psi even though the pipe wall was .322 in. thick. In case of vibration of the pipe, additional stress would be present. The total thrust down on the discharge bottle could be even greater. This could be compared to the flattening test for pipe. However, the gas pressure within the pipe would resist the vertical push to some extent. The amount that this pipe is pushed out of round and the amount it springs back to round could very easily be the amplifier for vibration.

I am only presenting this to you as a problem. I am not offering you an answer. However, such problems as this are the type that only some means of stress analysis can solve.

Another project we have been experimenting with is a suspension bridge. The primary purpose of the test was to measure additional stresses caused by wind. Considerable difficulty was encountered in getting a device for measuring strain in a wire rope but a differential transformer extensometer was used which was satisfactory except for the method of mechanical attachment, which must be tailored accurately to suit the conditions.

Vertical movement studied

During the course of experiments with the measuring device, studies were made of the vertical movement of the bridge. Recording anemometers and wind direction devices were installed. The temperature was also recorded. There were interesting developments recorded even though the attachment of the strain gauges had not yet been perfected. We found that the vertical movement of the bridge due to a 50-mph wind was about 7-in. and that the period of vibration was about 1 cycle every three seconds. Later a 94-mph wind was encountered. This showed how the amplitude of vibration picked up as the wind velocity continued to be high. The strain gauges being used at that time were knocked loose from the cable before the higher wind occurred but a lot of good information was obtained before they went out.

An additional line was placed on the bridge. Measurements were taken as each section of line was placed. The eccentricity of the loading was found to stress the cable but little. The impact due to movement of the pipe onto the bridge was very little but could be seen on the chart. Our measurment techniques were not as refined as we would like to have had them but they did very well within practical limits.

Additional tests

I have some other tests in mind which I hope to make when the opportunity presents itself. One of these is the positioning of piling under a compressor block. Usually we place piling with a uniform spacing under such foundations. Suppose a gauge was placed on the piles in the above situation and the wires brought out to a switchboard on the outside. Readings could then be taken on each gauge so that the distribution of the load could be found with a fair degree of accuracy. In all probability the results would show that certain piles were heavily loaded while others were only partially loaded. Either a savings could be made or a more efficient use of the same number of piles could be found.

We had a very similar case where we were building some pipeline suspension bridge anchors. We were having considerable trouble getting steel H piling. (The original design called for a uniform spacing of piling based on cores taken at the site previous to the design.) When we were about to run out of steel, a soil-bearing test proved that two anchors could be placed without any piling. How many times have we done things on such a basis as this? Along this same line, it is argued that the piling under a foundation takes all the load and that the soil takes none; yet the concrete has to be poured wet on the soil and no load can go to the piling until the concrete sets up. If gauges were placed on the piling before the concrete is poured, a measure of the proportion of the load taken by the soil could be found.

Another test I would like to try would be to place gauges in the columns of a building, say three gauges per column so that a fair load distribution over the column would be obtained. As the loads went on the columns the weight of each floor could be

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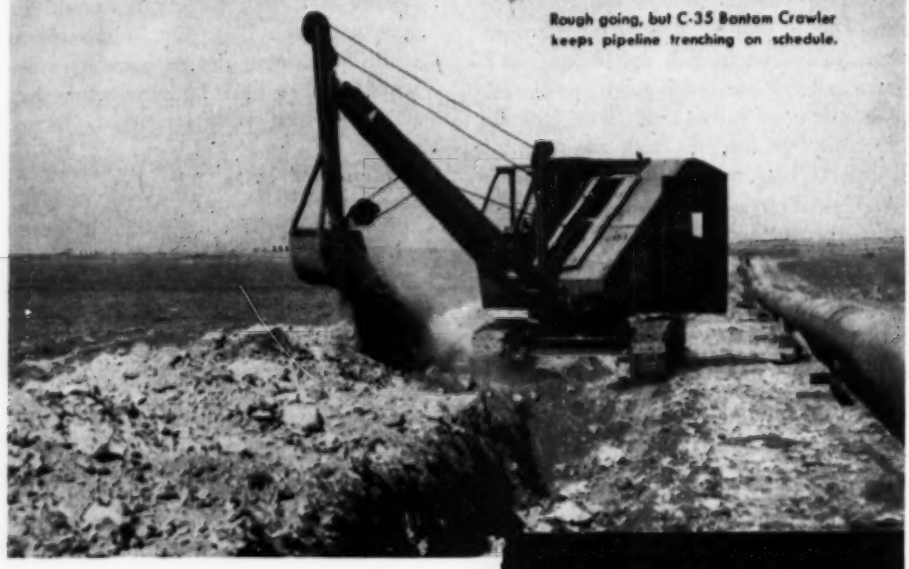

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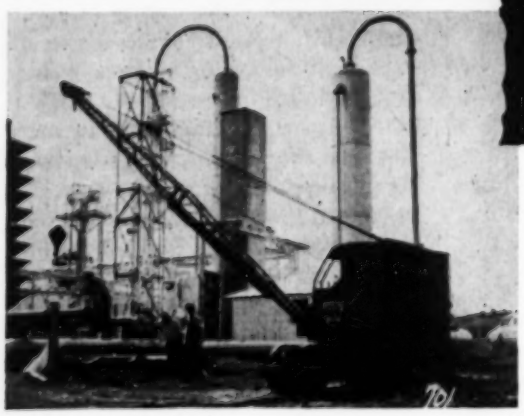

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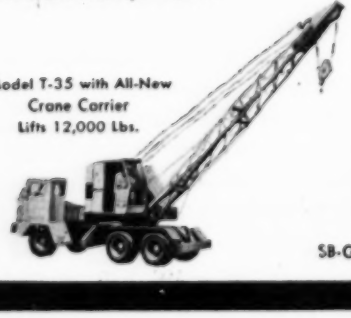

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measured. Then readings could be taken periodically so that any settlement could be analyzed by noting the change in the amount of load going to each footing. I feel that many surprising answers could possibly be encountered.

We have some lines going out into the Gulf of Mexico. There are probably many stresses and strains in the risers to the drilling platforms. We hope that sooner or later we may have the opportunity of checking a few of these with our gauges.

Precautions in the use of strain gauges

There are certain precautions that should be observed in the use of strain gauges. These were pointed out in a talk given by E. D. Nuttall of the United Gas Corp., Shreveport, at the ASME Petroleum Mechanical Engineering conference held in Houston last Sept. 28-30.

The instrumentation requirements for strain gauge analysis are relatively simple and of rugged design as compared to the instrumentation requirements for some other types of measurements. Carefully controlled wiring and gauge application techniques are a compelling necessity. Wire insulation must be of a type which will not absorb water, and solid wire instead of stranded wire should be used at all times if possible.

When measurements are to be made at distances exceeding 25 ft, I strongly recommend the use of a four-arm bridge circuit at the point of measurement. I would like to note here that the differential transformer operates as a four-arm bridge and thus complies with my recommendation. Water-proofing of gauges and wire connections to gauges must be carefully carried out to insure that there are no electrical leakage paths.

I cannot overemphasize the necessity of using the proper techniques when applying gauges to the test specimen. Proper cementing, proper curing, proper application pressure, and proper selection of the gauge type for the particular problem at hand and proper temperature compensation are as important as proper wiring and proper water-proofing. It all sounds hard, but it isn't. Proper techniques are not difficult to master and once mastered will insure you against measurement frustration.

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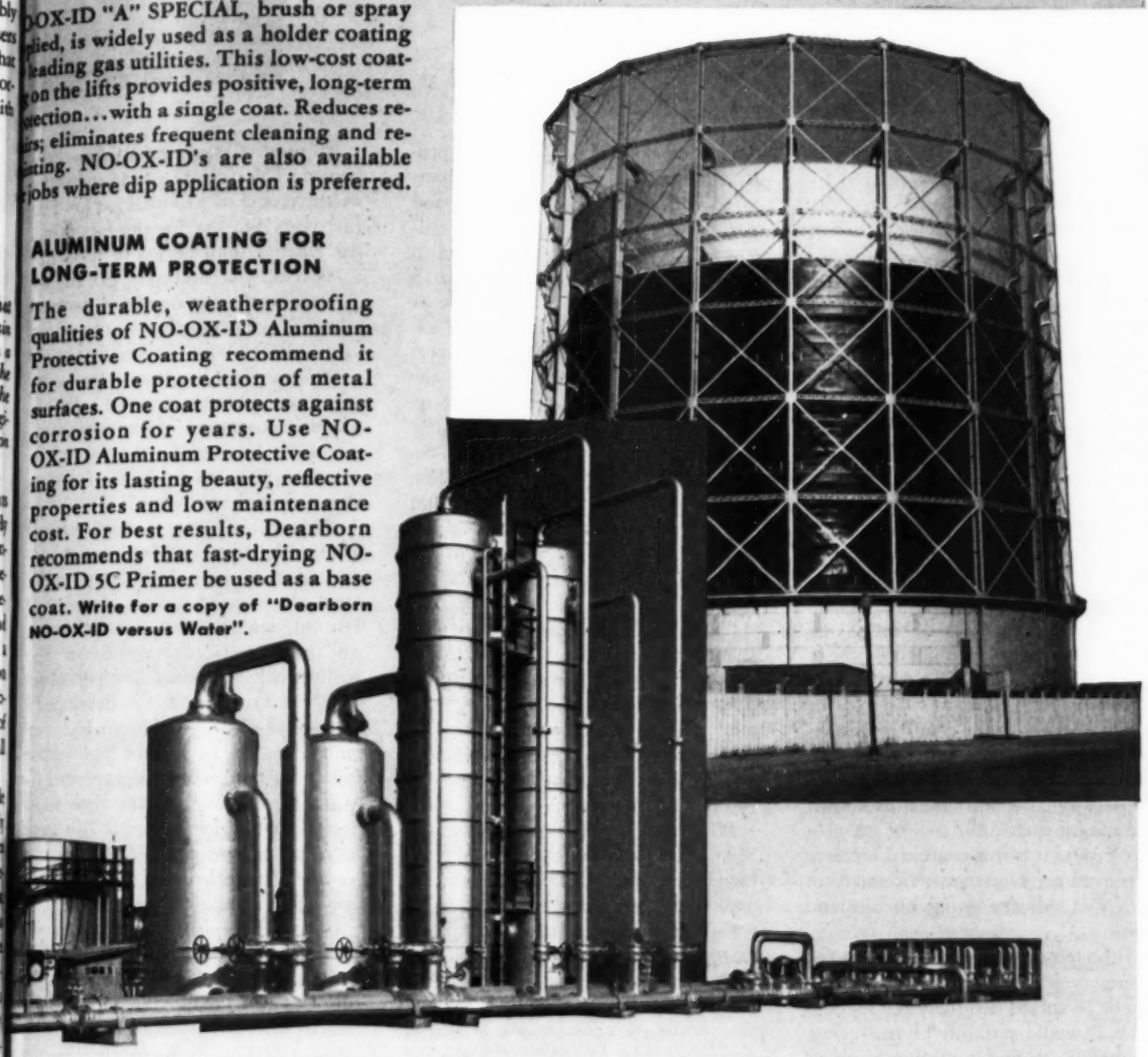

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The outlook for the gas industry

Long-range forecaster visualizes gas production at 12 to 14 trillion cubic feet in 1960.

By LYON F. TERRY • Chase National Bank, New York

THE supply of natural gas that will be available to the industry should be considered in two parts: first, the proved reserves as presently known, and second, the reserves to be discovered in the future. The American Gas Association's committee on natural gas reserves estimates the proved reserves of natural gas in the United States annually. Its last published figure, as of Dec. 31, 1952, was 200 trillion cu ft, which may be compared with production of the year 1952 of 8.64 trillion cu ft. Thus the ratio of proved reserves to annual production as last published was 23.2. Six years ago the corresponding ratio of reserves to annual production was 32.5. With the rapid expansion of the gas business since World War II, the ratio has been decreasing and will probably continue to decrease. However, this trend should not cause concern as long as additions to the known reserves of the country substantially exceed production. For the last five years of record, 1948-52, an average of 1.95 cu ft was added to known reserves for each cubic foot of gas produced. And it is this continual increase in proved reserves that is necessary to keep the industry going on a sound basis.

Although the problem of the size of the reserves to be found in the future cannot be solved definitely for years to come, it would certainly be reassuring, if possible, to find a minimum figure for the total future supply. In a paper presented before the annual meeting of the AGA in October 1950, I discussed the long-range problem of the future supply. And reasons were presented for estimating, on what I believe were most conservative premises, that the total future recoverable gas supply will *exceed* 500 tillion cu ft.

At that time the known gas reserves were estimated at 180 trillion cu ft, which has increased in the intervening three years to 200 triillion. The production for 1949 was 6.25 trillion compared with 8.64 trillion for 1952, and this may readily grow to 12 or 14 trillion cu ft by 1960. New gas added to proved reserves in 1951-52 averaged 15 trillion cu ft per year, and the rate of discovery, as in the past, may be expected to increase somewhat in proportion to increasing production. If the present rate of adding to proved reserves should increase but moderately during the next decade and then decrease gradually thereafter, 300 trillion of new reserves could be found within the next 20 years alone. Re-examination of the future supply from the standpoint of geological potentialities also leads me to the conviction that the old 500 trillion estimate was very conservative.

Hence, without attempting at this time to re-estimate the quantity, I am more and more convinced that the future supply of natural gas of the United States will be *considerably in excess of* 500 trillion cu ft.

It is evident that natural gas has been making great strides in serving larger and larger proportions of the total energy requirements of the country. The domestic demand for petroleum products, for comparison, has been increasing during the past 15 years at an average rate of 6.2% per year, while the consumption of coal is no higher than in 1917 and since the second world war has been falling off.

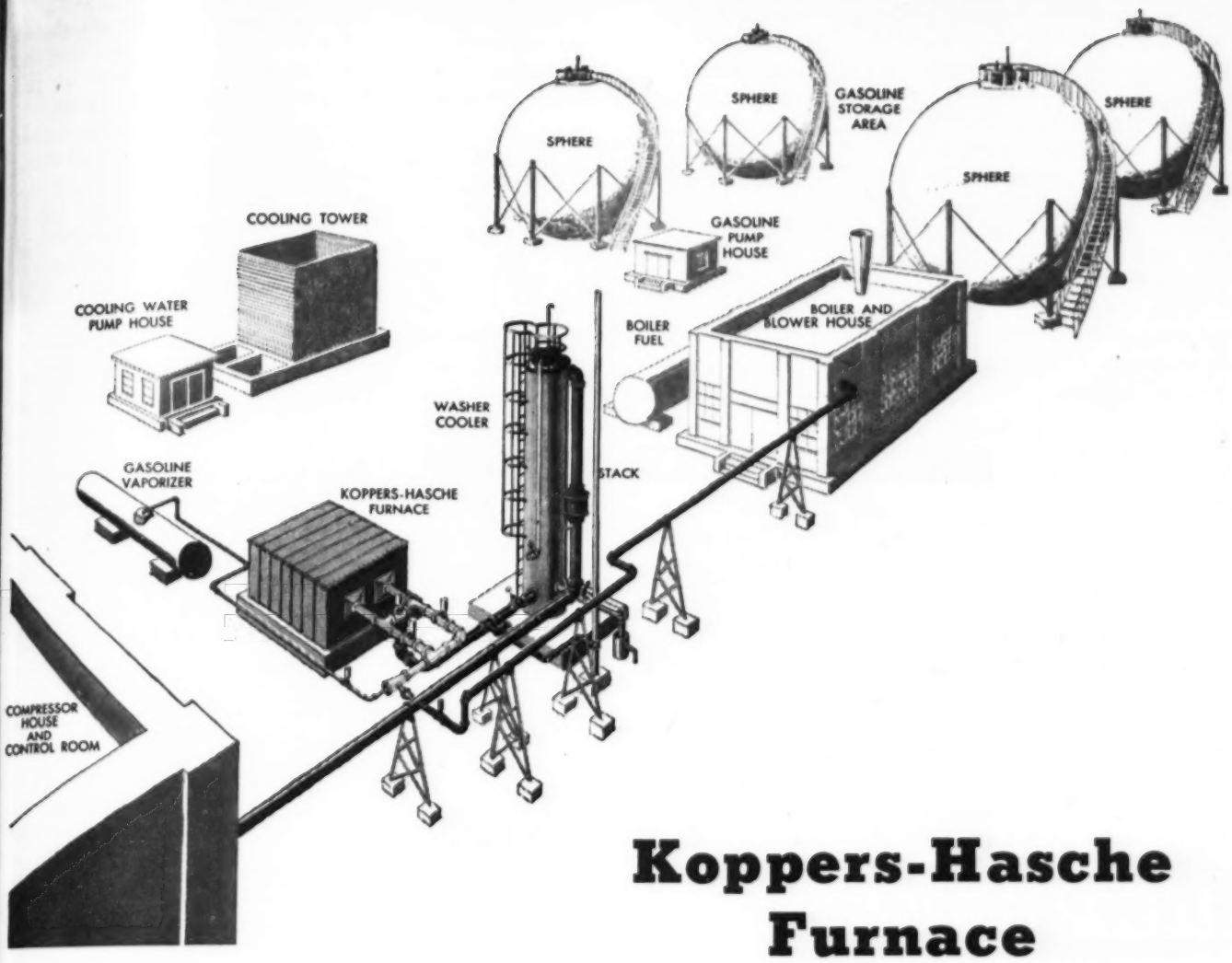
All these advantages have long been known. The utilities and industries would have chosen natural gas for their fuel years ago but for the fact that it has taken a long period of time (1) to develop the necessary gas supply, (2) for improving the art of transportation, thereby reducing the cost of carrying gas; (3) for markets to expand to the size that warrants transporting gas long distances; and (4) for the gradual recognition of the dependability of the business on the part of investors which has made the financing of such projects possible.

Prior to 1927 pipe for high-pressure gas lines was made of low carbon content steel of relatively low tensile strength. Higher test steel could be had but only with a higher carbon content and such steel could not be satisfactorily welded in forming pipe. About 1927, A. O. Smith & Co. developed a process of electric welding which permitted the use of steel of high carbon content having much higher tensile strength. About the same time seamless pipe of high strength also came into use. By the early 1940s cold processing of pipe became acceptable and the safety codes of the engineering societies were revised to permit the use of very high operating pressures. This all took many years to develop but resulted in increasing the former practice of operating relatively small pipelines at 400 psi to the modern practice of large lines operated at 800 psi. This

DATA ON AN OLD AND A MODERN PIPELINE

	Memphis	California
Year built	1928	1947
Pipe:		
Type	Lapweld	Electricweld
Diameter, in.	18	30
Thickness, in.	11/32	11/32
Steel:		
Yield point, psi	25,000	52,000
Max. hoop stress, psi	10,500	35,000
Max. line pressure, psi	400	800
Length in miles	211	214
Capacity with 2 stations (MMcf/day)	60	430

An abstract of a paper presented before the Jan. 28 meeting of the National Federation of Financial Analysts Societies.



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had the net effect of greatly reducing the cost of steel per unit of transportation—and steel is a principal cost of transportation investment.

The effect of the pipe diameter upon the cost of transportation per mile deserves particular attention. The capacity of long-distance pipelines is proportional to the 2.6 exponent of the diameter. Hence, assuming pressures and distance between stations to be equal, a 30-in. line will carry 2¾ times as much gas as a 20-in. line and 1¾ times as much as a 24-in. line. The cost of the lines, however, does not increase in such rapid proportion with increased diameters; hence, a considerable advantage and reduction in the cost of transportation result by using larger diameters.

In the table, a typical old pipeline is compared with a more modern line in California, I cite figures for the original Memphis Natural Gas Co. pipeline since I happened to be resident engineer during its construction and remember the factors.

Thus the new-type, high-test, large-diameter line has a capacity seven times that of the old 18-in. lap-welded pipeline. The cost of transporting natural gas has been greatly reduced over the years by improvements in the art and by increased volumes of business.

Natural gas is now being brought from Texas and delivered in the Philadelphia-New York area at approximately 32¼ cents per Mcf. Cost in the field is around 8¼ cents, indicating a transportation charge of 24 cents per Mcf for gas carried an average of slightly over 1600 miles. This is equivalent to roughly 1½ cents per Mcf per 100 miles at a high load factor—above 95%. If the load factor were reduced to, say, 75%, the corresponding carrying cost would be increased to around 2 cents per Mcf per 100 miles and thereby tend to price the gas out of the market.

As to the long-range outlook, several factors may be considered:

1. The increase in supply of natural gas available to the industry will, in my judgment, support a considerably further expansion of the markets.

2. Most of the competitive forces that have caused the rapid growth of the gas business will continue to be effective.

3. The field price of natural gas, however, is rising slowly and in the course of years will rise substantially, which will reduce the competitive advantage.

4. A gradual increase of 10 or 15 cents in the cost of natural gas will not greatly affect sales to residential consumers now comprising 57% of total revenues of the gas utility companies.

5. The use of natural gas for space heating offers a large potential market for expanding sales at good prices for many years. This market has been and will continue to be advanced by the increase in the standard of living.

6. All the basic forces reviewed are long-time factors that have developed over the years and should change very slowly.

7. The growth of the gas utility industry at the remarkable average rate of 10.3% per year since 1945 cannot be expected to continue indefinitely. But it is not through by any means. More gas will be discovered and more pipelines will be built. The rate of growth will no doubt slacken gradually, but the future potentialities are of a larger order. Considering the 50 years of growth of natural gas production, it appears reasonable to me that the country's production of approximately 9 trillion cu ft in 1953 may readily reach 12 or 14 trillion by 1960.

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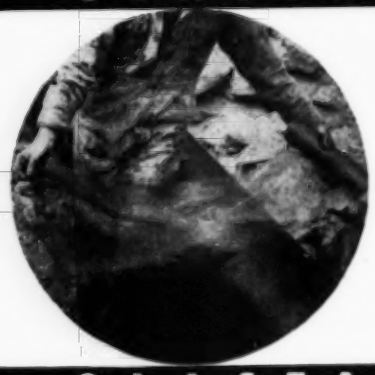

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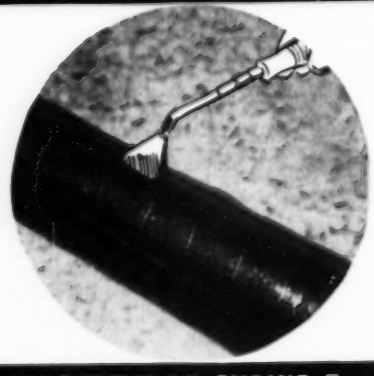

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Pipeline Communications and Electronics

By FRANK CHAPMAN

Obstacle-gain theory and the location of pipeline communication facilities

Frank Chapman

Recent experiments with long-range radio communications in mountainous regions demonstrating the use of knife-edge obstacles as a means of increasing the received signal strength may have a decided bearing on the future location of gas company communication facilities. Based on analyses of experimental data and interviews with scientists and engineers in the field conducted jointly by the Radio Corporation of America, the National Bureau of Standards, and the U. S. Army Signal Corps, indications are that the disadvantages previously attributed to the transmission of very high frequencies (30 to 100 m.c.) among high mountain ridges can actually become powerful aids for reducing both transmission loss and tropospheric fading. These "obstacle gain" experiments may result in the location of transmitter and repeater stations adjacent to gas transmission or distribution facilities rather than on an elevated location.

Prior to the experimental verification of the obstacle-gain theory, which predicts the possibility of tremendous power gains for VHF propogation over mountain obstacles, long-range communication installations were located so as to be in radio line of sight of each other. When possible, installations were made on the tops of mountains. While these sites were often relatively inaccessible, making construction and maintenance expensive, they were at the same time often not far removed from accessible property where gas transmission and distribution facilities were regularly installed and maintained.

It will be of considerable value, therefore, if, as indicated by the theory, VHF radio communication facilities can be located on or adjacent to property presently owned by the company.

The theory of obstacle-gain transmission is based upon the hypothesis that the transmission of very high frequencies over a knife-edge type obstacle should be considered as a four-ray combination of reflection, diffraction, and atmospheric refraction. Thus, if a transmitter and receiver are separated by a mountain the radio waves would be received by means of the following mechanisms: (1) Diffraction at the top of the obstacle; (2) reflection from the ground between the transmitter and the obstacle and then diffraction over the obstacle; (3) diffraction over the obstacle and reflection from the ground between the obstacle and the receiver; and (4) a combination of the two ground reflections with diffraction over the obstacle.

A requirement for the use of the obstacle-gain method for increasing signal strength is that the height of the obstruction must be greater than the elevation of the common horizon. For example, transmission losses will be considerably reduced at 100 m.c. if a knife-edge type of obstacle for a 150 mile circuit is at the midpoint of the path and about 1300 ft above the surrounding terrain. Theoretically these conditions should result in a 30-db decrease in transmission loss over that which would be calculated if the obstacle were not there with an accompanying increase in received signal strength. The amount of reduction in transmission loss can be varied by different combinations of antenna heights, obstacle heights, and frequency.

Radio waves transmitted over the theoretical smooth spherical earth are considered to arrive at points within the radio horizon by virtue of a normal diffraction process and by scattering from the turbulent atmosphere. The turbulence, which is greater near the earth's surface and decreases with increasing height into the upper atmosphere, is also considered responsible for the relatively weak and fading signals normally observed at distances beyond the horizon. The obstacle gains associated with a properly situated knife-edge ridge have been found to be large enough to reduce the transmission loss accompanying the reception of these signals beyond the horizon, thereby effectively eliminating the fading associated with the atmospheric scattering process.

A mountainous obstacle extending well above both the transmitting and receiving antennas requires the radio waves to pass through the most turbulent and disturbing regions of the atmosphere at relatively high grazing angles. With these large grazing angles, the amount of energy received from the highly turbulent regions in the screened lower portion of the atmosphere is effectively eliminated and so, in turn, is most of the tropospheric fading that normally exists on a nonobstructed path.

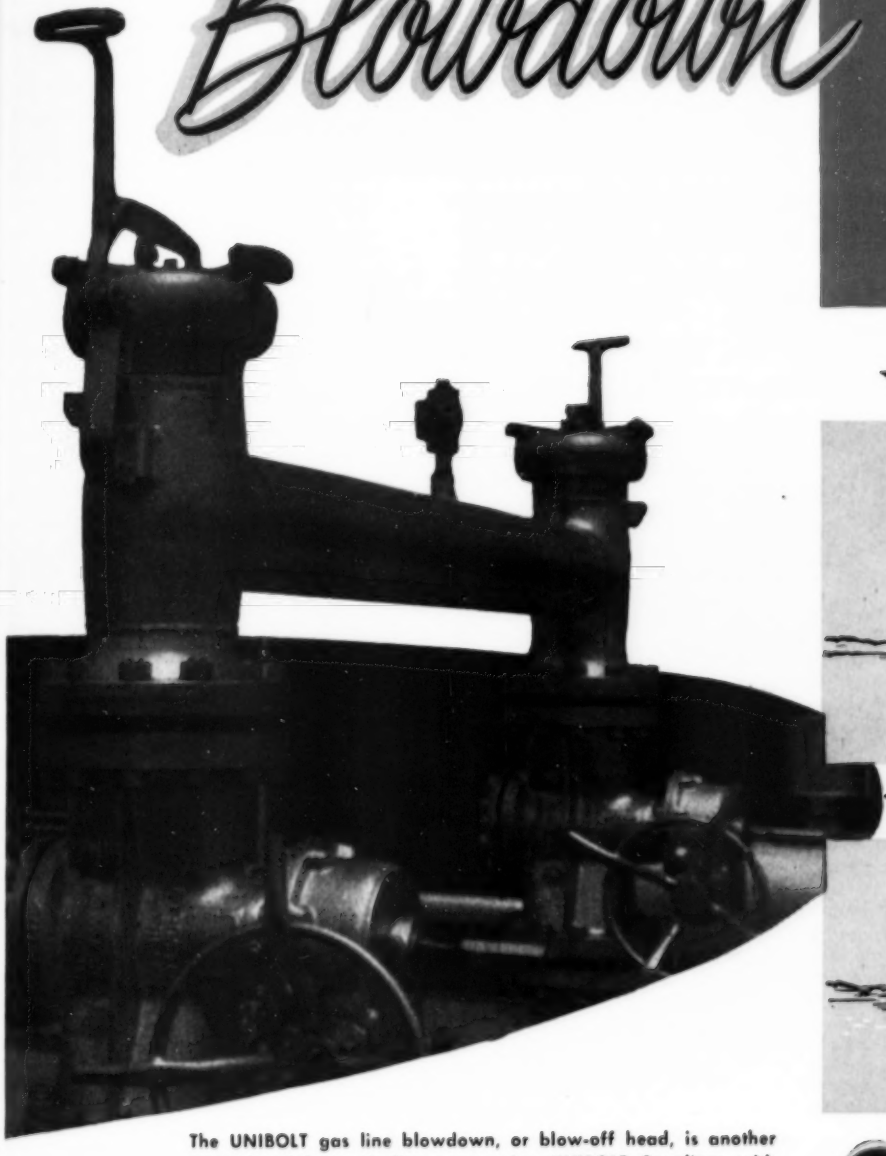
One of the experiments designed to substantiate this theory was conducted over a 30-day period on a 160-mile communication circuit between Yakutat and Gustavous, Alaska, operated by the Civil Aeronautics Administration. The operating frequency was 38 m.c. and both transmitting and receiving antennas were 50 ft high. The instantaneous transmission loss for the period varied by less than plus or minus 2-db from a mean value of approximately 134-db. Furthermore, the measured transmission loss was only 7-db greater than the loss calculated from the four-ray knife edge diffraction theory.

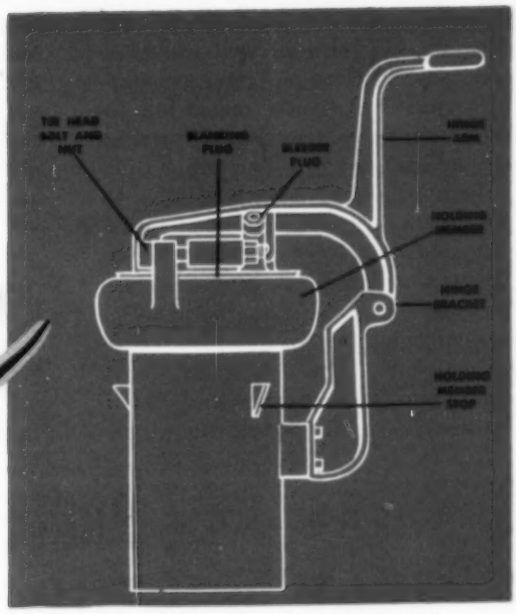
FCC to study microwave rules

Recent action by the Federal Communications Commission indicates that the study of a complete set of rules and standards for microwave communication is soon to get under way. According to Special Representative Joseph E. Keller of the Central Committee on Radio Facilities of the American Petroleum Institute, the FCC recently directed a letter to his committee requesting information with respect to industry opinion on the matter of allocation of

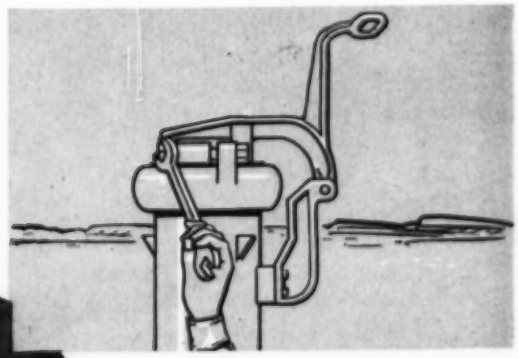
The "Lowdown" on the new Unibolt gas line

Blowdown

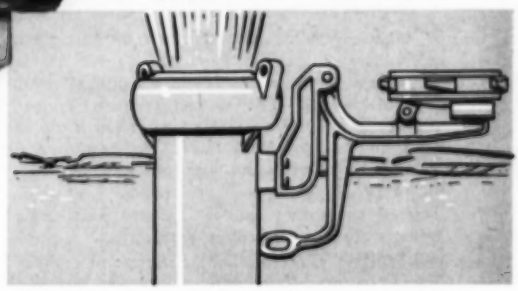


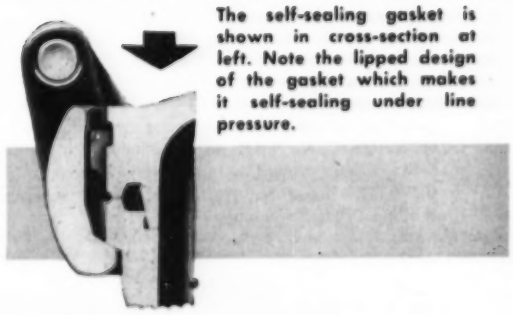


Release only two bolts and rotate the nut member slightly to disengage the tapered interlocking shelves.



A lever lifts the hinged blanking plug off and out of the way.





The self-sealing gasket is shown in cross-section at left. Note the lipped design of the gasket which makes it self-sealing under line pressure.

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frequencies above 890 mc. At the same time, the FCC also directed a letter to the Radio Electronics Television Manufacturers Association requesting information on equipment and operating characteristics in this spectrum.

In a letter to Chairman William M. Rust of the central committee the FCC requested, "as a representative of the largest single group of present users of private microwave systems and in cooperation with other groups that may be available . . . its analysis of the various operational communications requirements of the present known potential users of private microwave systems which could be satisfied by the use of frequencies above 890 mc.; together with its analysis of the suitability of each of the available microwave bands above 890 mc. for these purposes." In addition, the commission went on to ask the central committee to make a proposal insofar as microwave engineering standards are concerned.

In its letter to the RETMA, the commission said that, "it would be greatly appreciated if the RETMA would tabulate and furnish the commission, with respect to each microwave communications frequency band presently in use above 890 mc., the critical operating characteristics of the various equipments now installed, or available, from the standpoint of possible mutual interference between stations and equipments."

In its request to the central committee, the FCC went on to ask for proposals insofar as microwave engineering standards are concerned. The information was requested by the commission pursuant to its plan to form a joint study group "in the near future for the purpose of considering microwave rules and standards." The commission made reference to Docket No. 10500 and to the central committee's comments in that docket which urged, among other things, that the commission adopt complete microwave rules and standards.

Just prior to this action the central committee formally petitioned the FCC for an extension of time within which to file comments in Docket No. 10797. This docket is in the matter of amending the rules regarding microwave frequency allocations. The date for filing comments in this docket was Feb. 15, and the central committee requested an extension to March 15. The extension was requested on the grounds that both the commission and the industry would benefit by discussions of this proposal which will be had at the first meeting of the Microwave Frequency Coordinating Council held in Chicago on Feb. 24.

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Manufacturers request additional frequencies

The Committee on Manufacturers Radio Use, which is composed of 56 manufacturing companies over the country, filed a petition with the Federal Communications Commission on Dec. 14 requesting the establishment of a separate manufacturers radio service. The petition seeks an assignment of 40 exclusive frequencies to the new service in addition to those presently provided for by the commission for manufacturers in the special industrial radio service.

These 40 additional frequencies would become available by a reassignment of the 10-megacycle band between 460-470 m.c. which are now assigned to the citizens radio service. The committee went on to state that the "frequencies transferred from the citizens service to the manufacturers service could . . . be redeemed if the commission were to initiate a re-examination of the spectrum space reserved for government purposes and of the utilization of the frequencies assigned to the FM broadcast service in the 88-108 m.c. band . . ."

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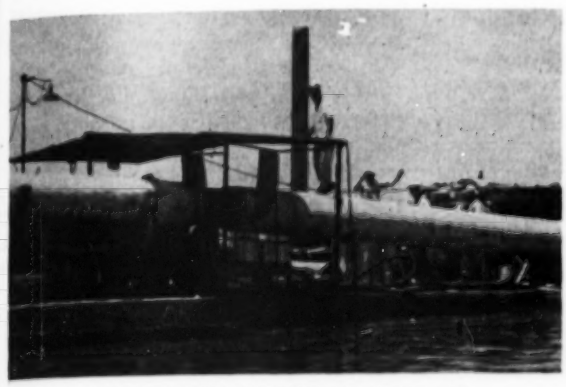

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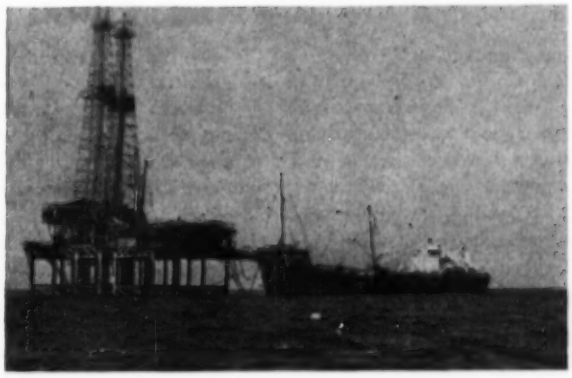
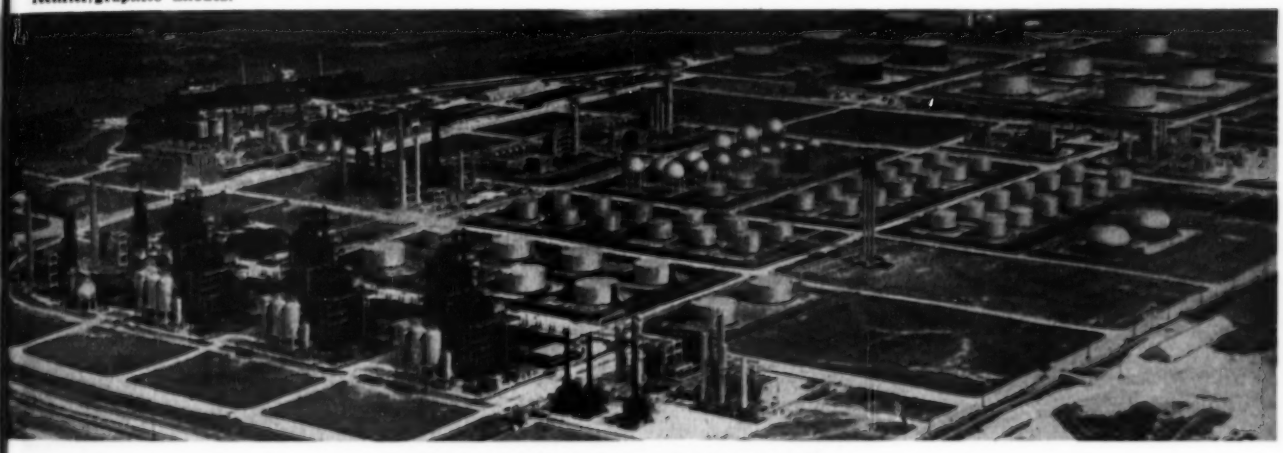


THE CALIFORNIA CO.

The above is typical of some 45 offshore drilling rigs which have been placed under protection by CPS Service Division. Installations were combination of the high current density electro-coating technique and magnesium anodes.



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PIPELINE NEWS

Texas gathering tax loses in Supreme Court battle

Interstate natural gas pipeline companies won their fight against the Texas gathering tax last month when the Supreme Court decided in their favor.

In a unanimous decision delivered by Justice Tom Clark (a Texan), the high tribunal ruled that pipeline companies that ship natural gas across state lines are exempt from the tax, and declared that the tax as applied by Texas to these companies interferes with interstate commerce. The tax, passed in 1951 by the Texas legislature, is levied on every "person" who gathers gas produced in the state "for the privilege of engaging in such business." It is imposed at the rate of 9/20th of one cent per Mcf of gas gathered.

The court's decision settled a "test case" brought by Panhandle Eastern Pipe Line Co. and Michigan-Wisconsin Pipe Line Co. on behalf of other firms that have been paying the tax under protest. Final decisions in more than 100 other lawsuits challenging the tax have been held up pending the high court's decision in this case. Neither of these companies is primarily in the gas producing business, but Texas applied its tax to them on the basis of the gas they "gathered" from outlets of gas-producing companies. The companies argued this point, and the court agreed with them.

Justice Clark wrote in the court's opinion: "The tax . . . applies equally to gas moving in intrastate and interstate commerce. It is levied in addition to all other licenses and taxes and is denominated an occupation tax for the privilege of engaging in the gathering of gas. Obviously appellants (Panhandle and Michigan) are not engaged in gathering gas with the meaning of that term in its ordinary use."

He went on to say that Texas applied its gathering tax at the point that gas passed from the producers' plant outlets into the pipelines of the appellants. But at this point, he said, the gas is already moving in interstate commerce and therefore is not subject to a state tax.

Justice Clark also attacked the Texas tax on the grounds that, if upheld, it would give birth to taxes by other states all along the line.

And in this last regard, an Oklahoma tax commission official said that efforts in Oklahoma to enact a similar levy will slow down as a result of the action. Lawmakers in the state for the past several years have introduced bills to tax natural gas that leaves the state, but the bills have always failed.

In Texas, meanwhile, Lone Star Gas Co., which was one of those opposed to the gathering tax, declared that any new move to tax natural gas will also be opposed. Texas legislators, scheduled to meet in special session about March 15, have before them three new bills designed to plug the gaping hole in state's revenues left by the Supreme Court's decision.

The effect of the bills would be to (1) raise $36 million yearly from a 1½-cent tax per Mcf on natural gas production; (2) fix minimum price of gas at 10 cents per Mcf, tax included; and (3) require that producers pass the tax on to purchasers.

The state now faces the prospect of having to return $6,207,180 in gathering taxes paid by companies that did not bring suit, in addition to the $25 million that will be recovered by the pipeline firms that won the Supreme Court suit.

N. Eldon Tanner heads Trans-Canada Pipe Lines

N. Eldon Tanner, 55-year-old western oil executive and for 15 years minister of Lands & Mines in Alberta, has been selected to head Trans-Canada Pipe Lines Ltd., the company that will build the 2240-mile gasline from Alberta gas fields across the Prairies, around the Great Lakes to Ontario and Quebec.

Other developments arising from the new project include Union Gas Co. of Canada's plan to build up the big potential eastern market in readiness for the west-to-east line. The company has already started arranging for franchises with townships in southwestern Ontario preparatory to purchasing rights-of-way for its proposed 160-mile line from Lambton county eastward to Oakville.

The governments of Ontario and Ottawa still have to decide on two points not yet settled: Should Consumers Gas Co. of Toronto be encouraged to build the Niagara transmission line to import U. S. gas during the market buildup period and to export Alberta gas after that? And, should the Trans-Canada line be of 30- or 36-in. diameter?

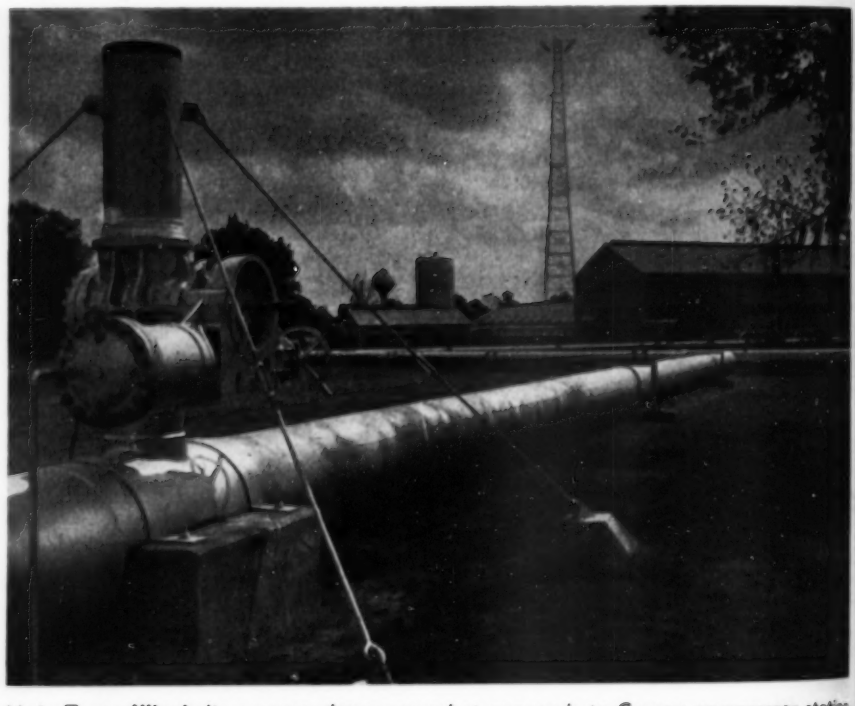
Long-range program of Texas Illinois completed

Daily transmission capacity of Texas Illinois Natural Gas Pipeline Co., one of two major long-distance pipelines supplying natural gas to Chicago region utilities, was increased by 130 MMcf on Feb. 8 upon the completion of an expansion program costing more than $35 million. The combined transmission capacity of the two systems now totals more than a billion cu ft of natural gas daily.

Six new compressor stations, five having a capacity of 12,000 hp and one of 10,000 hp, were placed in service along the 1400-mile 30-in. Texas Illinois line, extending from the Texas Gulf coast to Joliet, Ill. In all, 40 new internal combustion main compressor engines, capable of developing 80,000 hp, were installed in the course of the expansion program, which represents an investment of approximately $172 million.

Texas Illinois' capacity has been raised from the initial 374 MMcf to more than 500 MMcf by the added facilities. The dual lines of Natural Gas Pipeline Co. of America likewise have a daily capacity in excess of 500 MMcf. Both companies are subsidiaries of Peoples Gas Light & Coke Co.

Distribution companies benefiting by the increased supply include Peoples Gas, Public Service Co., Northern Indiana Public Service

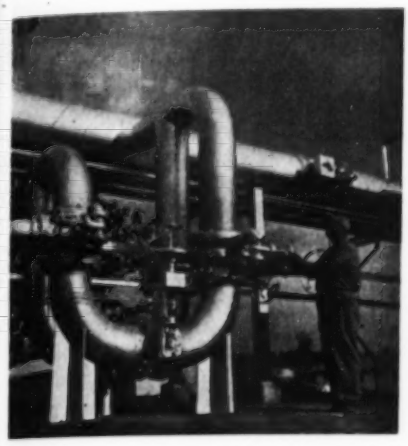


Main Texas Illinois line comes above ground at approach to Conroe compressor station, one of 11 such plants powering the company's 1400-mile line.

Co., North Shore Gas Co., Allied Gas Co., Union Gas & Electric Co., Iowa Illinois Gas & Electric Co., Central Illinois Electric & Gas Co., Iowa Power & Light Co., Iowa Electric Light & Power Co., and Interstate Power Co.

Addition of the 40 main compressor units has resulted in an increase in gas flow speed from about 12 miles an hour to approximately 15¼ miles.

The six new stations are located near Wharton and Lufkin, Texas; Texarkana and Searcy, Ark.; Perryville, Mo.; and Decatur, Ill. The original stations are near Conroe and Marshall, Texas; Malvern and Pocahontas, Ark.; and Hoffman, Ill. Each station is a self-contained community with its own power, water supply, garage, and machine shop, as well as modern family housing units for personnel.



This cluster of water jacket temperature controls at Conroe is typical of automatic and semi-automatic control mechanisms at the compressor stations.

Permian-El Paso project approved by commission

Approved changes in previously authorized pipeline facilities will permit Permian Basin Pipeline Co., Chicago, to transport gas for El Paso Natural Gas Co., El Paso, from the Spraberry area in Midland county, Texas, through about 96 miles of existing line to El Paso's Plains compressor station in Yoakum county, Texas. (See November *GAS*, page 106.) From there the gas will be redelivered to El Paso for transportation and delivery to its markets.

The new modification (Dockets G-2106, G-2270, and G-2283) modifies an FPC order issued last June so as to delete from El Paso's certificate the 122-mile Spraberry-to-Plains pipeline and to change authorizations in compressor station horsepower and interconnecting pipelines. El Paso also was authorized to abandon about 11 miles of pipeline, which no longer will be needed, and Permian received permission to install two additional 1320-hp compressor units at its Spraberry compressor station. The changes will eliminate the necessity of Permian and

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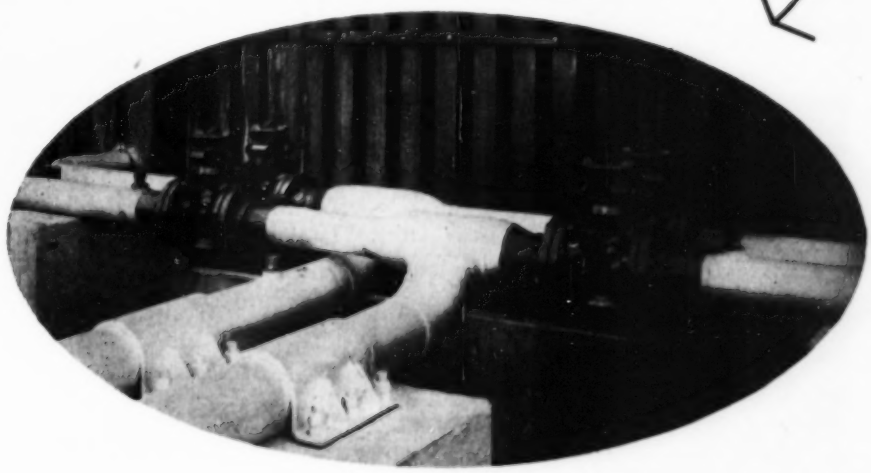

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1954 prospects good, pipeline contractors told

A 14 to 15% drop in 1954 construction activity for pipeline contractors was predicted at the annual meeting of the Pipeline Contractors Association held in Houston recently. However, the year should still prove to be a big one for the builders, according to Association President Robert Thomas, of Texas-Louisiana Constructors.

Last year, he said, 14,000 miles of lines were laid, including 5000 miles of natural gas transmission lines, 5000 miles of crude lines, and 4000 miles of product lines.

One of the top subjects at the convention was safety, which was stressed in R. P. Gregory's talk on "Safety in Pipeline Construction." Mr. Gregory, of Houston Contracting Co., emphasized the importance of setting up and conducting an effective safety program designed to acquaint personnel with the dangers involved in pipelining and how to cut down on accidents.

J. Doyle Settle, assistant to the vice president of the American Association of Oilwell Drilling Contractors, spoke on savings derived from safety practices. C. C. Whittlesey, of Ford, Bacon & Davis Corp., spoke on the relationship of the engineer to the contractor; A. W. Tolman Jr., Peat, Marwick, Mitchell & Co., spoke on the importance of accounting to the contractor.

G. A. Manuel, president of Williams-Austin Co., was elected president of the contractors' group. Other new officers are James P. Neill, Western Pipe Line Constructon Inc., 1st vice president; Clark C. Bledsoe, Midwestern Constructors Inc., vice president; and John M. Thomas, H. C. Price Co., treasurer.

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Wyoming to be site of new gas gathering plant

Wyoming Gas Products Corp. has been formed by Allen & Co., New York investment bankers, and Murchison interests of Dallas to construct a $5 million gas gathering system and processing plant in the Newcastle, Wyo. oil area.

Homer S. Head & Associates of Houston recently announced plans for a $4.5 million gas collection system and processing plant in the same area. Both announcements said the firms intend to process some of the 30 MMcf of gas daily being flared from wells in the area.

The announcement by the Allen-Murchison group said Fish Engineering Corp., Houston, has been "engaged for many months in the engineering aspects of the project." The completion target date is late summer or early fall.

Gas processing plant to be built in Woodlawn field

The Woodlawn Processing Co. has been formed to construct and operate a gas processing plant in the Woodlawn field of Harrison county, Texas, by operators in the pool.

Cost of the project was set at $1,635,000 and contract to erect the plant has been let to the Hudson Engineering Corp. Work was expected to begin about March 1.

Plans also call for construction of a pipeline from the field, eight miles north of Marshall, Texas, to the Carthage Corp. plant in the Carthage field of Panola county, which will handle the liquids. A long-term contract for gas output from the field is held by the Mississippi River Fuel Corp.

Pacific Northwest hearing disputes continue

Disputes over reports of adequate reserves spotlighted recent FPC hearings on who is going to pipe gas to the Pacific Northwest. William F. Devin, Seattle counsel for the Pacific Northwest Pipeline Corp., proposing to bring gas from the San Juan basin, said late in January a new official report by Alberta provincial authorities reduced sharply the reserve figures cited by Westcoast Trans-

mission Co., proposing to serve the northwestern area with Alberta gas.

In turn, an exhibit on natural gas reserves in the San Juan basin raised Westcoast hopes—the exhibit estimates that Pacific Northwest would run out of gas after the second year's operation of its proposed line.

The hearings, which are setting records for length, are believed to be actually drawing to a close, with time estimates running from April to two or three more months.

In another application, Northwest Natural Gas Co., New York, has asked the FPC to let it amend its original application, which proposed to serve the "Inland Empire" of eastern Washington and areas closely adjoining, in addition to the coastal area of Washington; Portland, Ore.; and Vancouver, B.C. Under the proposed amendment, the company now plans to serve only the Inland Empire, in northern Idaho and eastern Washington, with some gas to be returned into Canada for use in Trail and elsewhere in British Columbia.

Mississippi River can serve steam electric boilers

Reversing an order issued last May 11, the FPC has authorized Mississippi River Fuel Corp., St. Louis, Mo., to construct pipeline facilities to supply natural gas on an interruptible basis to Union Electric Co. of Missouri for use in firing steam-electric boilers in its new Meramec generating plant in St. Louis county, Mo.

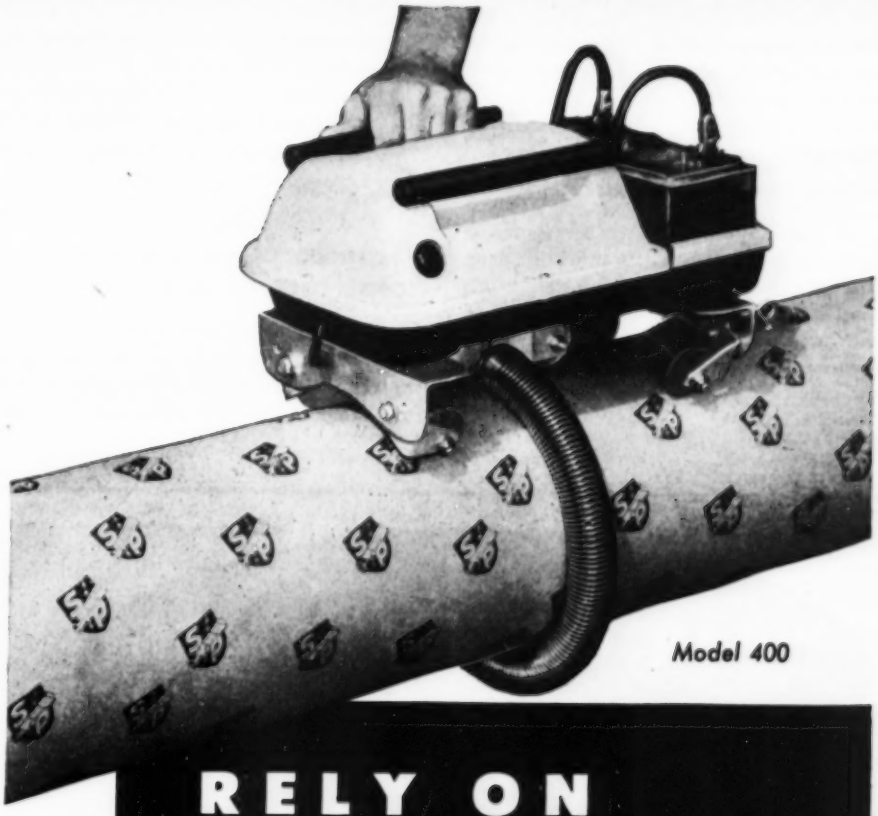
Evidence presented at the rehearing showed that direct industrial sales by Mississippi declined sharply in 1953 to a level substantially below that shown during the test year used for rate fixing; that the company's system load factor may be expected to continue to decline; and that effective storage operations have not been commenced by either Mississippi or its principal resale customer, Laclede Gas Co. (of St. Louis, Mo.).

The commission said that this case falls in the twilight zone insofar as public convenience and necessity is concerned. "The utilization of large volumes of natural gas under boilers of an electric generating plant tends to dissipate natural gas reserves otherwise available for essential domestic and general service use, but other facts and circumstances of record outweigh the adverse effect due to gas utilization," the FPC asserted.

El Paso to build line in Reagan county, Texas

The El Paso (Texas) Natural Gas Co. has applied to the FPC (Docket No. G-2356) for authority to construct pipeline facilities to enable it to acquire 20 MMcf of gas daily in Reagan county, Texas.

The proposed project, estimated to cost $798,600, would include about 32½ miles of 10¾-in. pipeline extending from the Barnhart Hydrocarbon Corp.'s gasoline plant in Reagan county to a connection with El



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Paso's existing system in Upton county. The company also would build a purchase meter station.

Washington State holds corrosion course

A five-day short course in corrosion was held on the campus of Washington State College, Pullman, Feb. 1-5. The course consisted of a brief but intensive review of the fundamental aspects of corrosion followed by panel discussions and lectures on the application of methods to control corrosion in industry.

The division of Industrial Services of the Washington State Institute of Technology and the National Assn. of Corrosion Engineers sponsored the course jointly. M. F. Adams, Washington State College, was program chairman.

Transco plans Louisiana construction and sale

Transcontinental Gas Pipe Line Corp., Houston, has applied to the FPC for authority to construct a 19-mile, 12-in. pipeline and to abandon by sale an existing 14-mile, 6-in. line in Vermilion parish, La., to enable it to take additional volumes of gas over a longer period of time from the West White Lake field.

The company has recently negotiated its contract with Union Oil Co. of California covering the field to increase the take from the 1953 average of 13,555,000 cu ft of gas per day to a contract minimum of 31,101 Mcf and a maximum of 41,464 Mcf per day. The period of time that Transco may take gas from the field was extended to Nov. 1, 1974.

Transco proposes to sell its existing line, with a capacity of 15 MMcf per day, to Union Oil for $341,068.

Court of Appeals turns down Interstate plea

The ninth Circuit Court of Appeals has affirmed a lower court decision rejecting the claim of a producer, Interstate Natural Gas Co., for damages against a pipeline company, Southern California Gas Co., for failure of the pipeline company to transport the gas of the producer with whom the pipeline company had no contract.

The court held that the producer's claim is in effect a collateral attack against an order of the FPC, and that the producer's real grievance concerns the pipeline's contract for carrying the gas of other producers. It pointed out that the construction of the pipeline involved was based on a 30-year contract, whereby the pipeline company obligated itself not only to carry a minimum of the pipeline's load factor of 91% of the pipeline's capacity, but for its entire use if necessary.

The FPC, after a public hearing, issued a certificate authorizing construction and operation of the pipeline upon the terms of which the producer complains and the pipeline company is bound to conform to the provisions of that contract unless relieved therefrom by the commission. The pipeline could not carry the producer's gas without violating the contract and the certificate, the court said, and the producer cannot by means of this suit for damages indirectly annul the action taken by the FPC.

Posted bonds replaced by "written undertaking"

Through action making Colorado Interstate Gas Co.'s $6,508,000 wholesale natural gas rate increase effective, the FPC has issued an order calling for a "written undertaking" to assure the refund of any excess charges to its customers instead of the usual bonds which in the past were to be furnished by the company to assure the refund.

Under the Natural Gas Act, if a rate-suspending proceeding is not concluded at the end of the suspension period, the increase may be made effective, subject to the refund. The Act also provides that the commission may direct the company to furnish a bond, but does not require that this be done. Up until now, however, the FPC has required the posting of bonds, usually in the amount

Pat. 1,234,567
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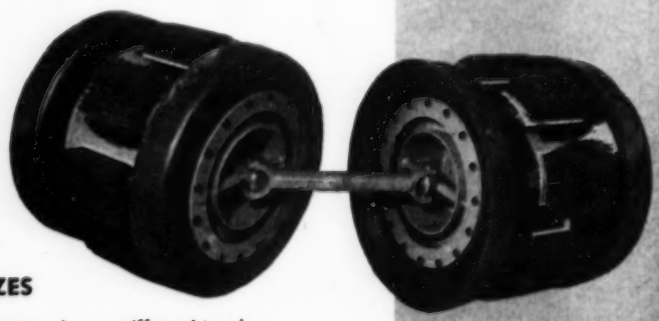

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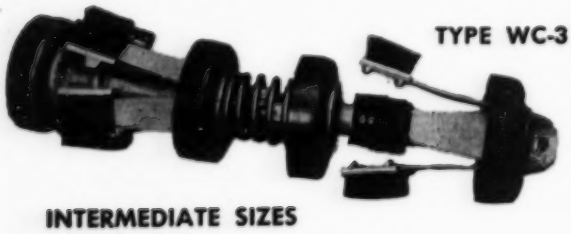

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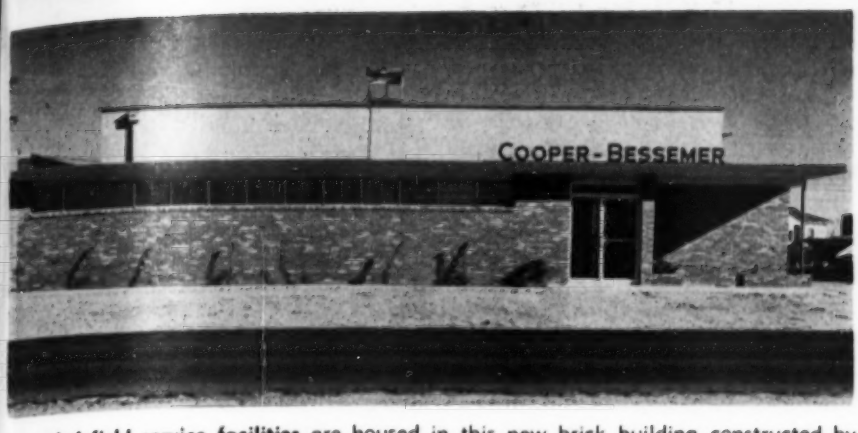

Expanded field service facilities are housed in this new brick building constructed by Cooper-Bessemer Corp. at Odessa, Texas. The new structure houses 1715 sq ft of office space and 3725 of warehouse area. A 2-ton traveling crane for expediting delivery of heavy engine and compressor parts to the Texas area is used in the warehouse.

of about 10% of the requested increase. The new policy will effect some savings for the natural gas companies, which should be of ultimate benefit to consumers.

The commission's order requires the Colorado Springs company to refund, together with interest at the rate of 6% per year, amounts found not to be justified. The company must also keep accurate accounts of all amounts collected by reason of the increase, and report the same to the commission monthly for each billing period. The written undertaking, to assure the refund of any excess charges, must be filed within 15 days.

Northern Natural's rate boost of $6 million okayed

The Federal Power Commission has approved a settlement providing for a $6,006,000 annual increase in wholesale natural gas rates by Northern Natural Gas Co., Omaha, instead of a $13,193,000 per year increase originally requested by the company. The settlement was reached late in January after a series of conferences held earlier in the month. Agreement was reached on all issues, except one concerning service zones and differentials in rates in areas served by Northern. Further hearings on this point are scheduled for March 22.

In other actions, the FPC made effective two proposed increases by United Gas Pipe Line Co., Shreveport, and one by Natural Gas Pipeline Co. of America, Chicago, subject to the filing by the two companies of written undertakings to assure the refund of any excess charges. (See news story in this issue.)

Natural's increases, effective Jan. 1, total about $7,210,000 annually. United's increases, for $827,000 and $100,000, are effective as of Dec. 25 and Jan. 1, respectively.

The FPC also approved a proposed settlement of a rate case which will allow United Fuel Gas Co., Charleston, W. Va., to retain an additional $1,048,000 per year of revenues from the wholesale rates which the company has been collecting under bond since last Feb. 15. The new rates allow a 6¼% rate of return.

A request from Tennesse Gas Transmission Co., Houston, to shorten the suspension period of a proposed $6.51 million increase has been denied. Tennessee wanted the effective date to be Jan. 12 instead of March 1.

The commission also scheduled a Feb. 23 hearing on South Jersey Gas Co.'s $57,000 increase; postponed hearings on East Tennessee Natural Gas Co.'s increase until March 3; on Transcontinental Gas Pipe Line Corp.'s increase until March 8; and Columbia Gas System subsidiaries increase until March 2.

Two proceedings involving Alabama-Tennessee Natural Gas Co., Florence, Ala., were consolidated. One involved proposed changes in general service rate schedules; the other a proposed rate increase.

The commission also rejected a proposed $426,417 increase proposed by East Tennessee Natural Gas Co., Knoxville, and directed the company to file a new schedule for a $132,939 increase.

Oral arguments were scheduled for Feb. 18 on Michigan-Wisconsin Pipe Line Co.'s suspended $7,643,000 and $3,772,000 increases.

Pacific Lighting Gas Supply Co., Los Angeles, has filed an application with the California PUC for rate increases designed to produce $3.4 million additional annual gross revenues.

Dearborn expands pipeline sales and service

A new pipeline sales and service division has been organized by Dearborn Chemical Co., Chicago, and the technical field service department has been reorganized to keep pace with the fast moving developments in the pipeline industry.

R. F. Carr, vice president, will head up the new division and Paul B. Payne, former manager of the Indianapolis office, has been named sales manager. The new division will be staffed by trained and experienced personnel. The technical service department will handle product development and field service in matters dealing with transmission systems coating materials.

Regional sales offices have been set up in Dallas, Denver, Detroit, Los Angeles, Nashville, Pittsburgh, and Linden, N. J.

Texas Gas and subsidiaries plan lines and increases

Plans for 24 miles of 16-in. line in south Louisiana gas fields, installation of an additional 2000-hp compressor unit at Bastrop, La., and erection of a purchase meter station in south Louisiana were filed by the Texas Gas Transmission Corp., Owensboro, Ky., with the FPC on Jan. 29. An expenditure of $1,596,000 is called for.

At the same time, Louisiana Natural Gas Corp. and Texas Northern Gas Corp., both wholly owned Texas Gas subsidiaries, filed petitions with the FPC seeking removal of volumetric limitations on the deliveries of gas they may make to their parent company. The new facilities are designed to handle added quantities of gas that would be received from the two subsidiaries. Texas Gas' application points out that the facilities are necessary to provide flexibility for operation under existing gas purchase contracts and capacity for the acquisition of additional reserves.

Total deliveries of the two subsidiaries to Texas Gas now are limited by the FPC to 140 MMcf per day. After the installation of the proposed facilities, it was shown, the daily deliveries can be increased to approximately 197.7 MMcf. It was also pointed out that the primary purpose of each subsidiary is to gather gas for delivery to Texas Gas, and that the present limitation creates an unnecessary restriction on the fulfillment of this purpose.

The pipeline would extend from existing interconnection of the facilities of Texas Gas and Louisiana Natural in the North Tepetate field to a point of interconnection with existing facilities of Louisiana Natural near the South Roanoke field in Jefferson Davis parish. The purchase meter station would be installed at the interconnection point near the South Roanoke field.

Transco seeks to serve New York area 61.5 MMcf

Transcontinental Gas Pipe Line Corp., Houston, has filed an application with the FPC for permission to serve an additional 61.5 MMcf of natural gas per day through its 134th street and Narrows Crossings to the New York joint facilities to be distributed as follows: Consolidated Edison Co. of New York, 30 MMcf; Brooklyn Union Gas, 25MMcf; Long Island Lighting, 5 MMcf; Brooklyn Borough Gas, 1 MMcf; and Kings County Lighting, 500 Mcf.

Included also in the application is a re-

CLEANING, COATING, WRAPPING & RECONDITIONING

★

HOT DOPE

Straight from the Kettle on PIPE PROTECTION

★

By Boyd Mayes

● The year 1954, according to most prognosticators (WOW! how'd I ever spell that one?) is going to be the biggest construction year in the history of pipelining. Sounds mighty rosy to us folks out here in the coating, wrapping, weighting and reconditioning business. Sure hope those prognos — what-ever-you-call-'em know what they're forecasting around. There's little we'd rather do than get in on the job of helping pipeliners make a better job of all this work. We've been doing it for 27 years now, and our enlarged plant loaded with skilled manpower is ready for business, whatever the size.

We've always been one of those strange critters who believes that optimistic talk makes for good business and that good business is the backbone of the country. We can remember back when some of our 27 years had some kinks in them; also some twists . . . but all you got to do is look to see that the folks who had faith in hard work and in *doing one job well* sure survived.

MAYES BROS.

1150 McCarty HOUSTON, TEXAS Oldard 7346

quest for authority to serve 30 MMcf per day to Pubic Service of New Jersey.

Transcontinental states that it will shortly file an additional application for a certificate for expanded service to its customers in Philadelphia and South Jersey, Delaware, North and South Carolina and other southern states along its line. The service requested in this additional application will not conflict with that proposed by Tennessee.

Transcontinental states that its price for gas in the New York market will be one cent per Mcf cheaper than Tennessee's rates. Transco's proposed rate takes into account certain escalations in gas prices resulting from the renegotiation of existing purchase contracts, and a rate increase would be required even though no additional quantities of gas were offered.

The application also points out that it is in the public interest that Transcontinental be permitted to serve the New York and New Jersey markets because its line traverses the shortest possible route from the Gulf coast gas fields to the eastern market, and was designed primarily for such service.

Transcontinental also announced that it is seeking permission to build facilities that will add an additional 20 MMcf of line capacity on or about November 1, 1954 to be used for transportation of 10 MMcf of gas per day for the Sun Oil Co. to its Marcus Hook refinery in Pennsylvania from Sun's Gulf Coast gas supply. The remainder of this will be for present customers.

"Duratex" name belongs to National Pipe Coatings

It has been found by the district court of the United States, central division of the southern district of California, that National Pipe Coatings Inc. is and has been sole proprietor of the trade name "Duratex" and that any and all good will attached thereto is the exclusive property of that company.

National Pipe Coatings, with offices in Houston and Nevada, is engaged in the manufacture, sale, and application of pipe coatings and primers.

The findings of the court prohibit the defendants in the suit from manufacturing materials similar to National's formulas.

FPC must rehear Colorado Interstate case

The U. S. 10th Circuit Court of Appeals has reaffirmed its 1952 ruling, involving the FPC and Colorado Interstate Gas Co., Colorado Springs, which ordered the FPC to grant another hearing to the company that had been ordered to reduce its wholesale gas rates by $3 million.

The FPC asked the court to reconsider the case. The court did, and in Presiding Judge Huxman's opinion, the court held its earlier decision was proper. The FPC contended the original reversal was ordered on a point not originally raised before the commission.

Pipeline Notes

Southern Natural Gas Co., Birmingham, has been directed by the FPC to supply gas to the Northwest Alabama Gas District, Hamilton, Ala., and to the city of Fayette, Ala. The district will distribute the gas in nine Alabama communities and will transport for Fayette gas which that city will purchase from Southern.

Volume 10 of the "Federal Power Commission Reports," which contains opinions and decisions for the calendar year 1951, was released by the FPC last month. Included are formal opinions, intermediate decisions which have become final, and an appendix of selected orders in the nature of opinions. Copies are available from the Publications division, FPC, Washington 25, D. C., at $4.75 each. (Order No. FPC A-45.)

A schedule of fees that the FPC proposes to assess in connection with the filing of applications and the granting of authorizations for the export or import of natural gas and for certificates issued under the Natural Gas Act has been released. In addition to the filing of fees, the FPC proposes to set up a second schedule of fees, designated as certificate and authorization or permit fees.

"Three Stars for the General" is the title of the biography of Ernest O. Thompson, chairman of the Texas Railroad Commission, which has been scheduled for publication late this spring. Author of the book, to be published by Random House, is James A. Clark, co-author of "Spindletop." Besides the life story of Colonel Thompson, the book deals with the development of petroleum conservation from the time of the east Texas boom.

The eighth annual meeting of the Texas Independent Producers and Royalty Owners Assn. will be held at the Rice hotel in Houston, April 4-6. During the meeting members will decide whether to abandon efforts at a solution to the oil imports issue through voluntary action on the part of major importers and seek a legislative approach.

The chemical plants division of the Blaw-Knox Co., Pittsburgh, won first place in the national accident prevention contest of the Associated General Contractors of America for 1953. The award recognizes the best safety record in Group A, which includes contractors doing the largest volume of work, or more than 500,000 man hours annually.

Texas Eastern Production Corp., with financial assistance from its parent, Texas Eastern Transmission Corp., Shreveport, has purchased the Triangle Pipeline Co. at a price of more than $3.1 million. This marks the entry of Texas Eastern into the field of transportation of refined oil products.